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fungi

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Alina Skirgiełło

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BASIDIOMYCETES
BOLETALES

(Grzyby)

Podstawczaki; Borowikowe

Translated from Polish

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INTRODUCTION

Parallelly to the descriptive flora of vascular plants in Poland, published in many volumes by the Polish Academy of Sciences, at present the publishing begins of an analogous descriptive flora of cryptogamous plants in Poland. In view of the great variety of this material the new publication has been divided into independent series comprising individual plant groups, i.e., Mosses, Liverworts, Myxomycetes, Algae, Lichens and Fungi.

Since the enormous material concerning fungi is elaborated by many mycologists it will be prepared at various periods of time; thus, in order to render accessible the ready materials, the Institute of Botany of the Polish Academy of Sciences decided to publish individual parts or volumes, already prepared, notwithstanding the systematic order.

The series "Fungi" is initiated by the present volume: *Boletales*.

The first chapter of this book involves short indications for those interested in pileate fungi.

The main text comprises descriptions of species, genera, families and of the order as well as keys for identification and illustrations. For better lucidity the dichotomic keys are placed before each systematic unit. Each unit indicated in the key is provided with the number of the page on which its description is given.

In the range of a genus the species have serial numbers. If this number is given in brackets, it denotes that the given fungus hitherto was not found in Poland but its occurrence is very probable. If instead of the number a dash is given, it also indicates that the given species was not observed in Poland, but the possibility for its occurrence is doubtful, though conceivable. These fungi have been included in this work since their occurrence was established in central or northern Europe.

Notes concerning the occurrence of individual species in Poland have been elaborated on the basis of literature pertaining to Polish and neighboring areas as well as on the basis of herbarial materials. All the sites of occurrence are given only in the case of rare or less known species.

In most species only a minimum number of synonyms are given indispensable for an orientation in the recent mycological literature.

All the figures are original designed by the author on the basis of fresh specimens. Only six figures are copies also made by the author on

the basis of Kallenbach's monograph. They present fungi sometimes wrongly identified and rarely occurring in Poland.

At the end of the description of each species, besides the number of the author's color drawing, also a number is given of one of the best color reproduction of drawings or photos found in well known mycological atlases; a comparison with them may be helpful in the use of foreign works.

The included list of literature comprises only foreign recent works used in the elaboration of *Boletales*.

A vocabulary of the most important mycological terms concerning pileate fungi is given at the end of the book.

The author is greatly indebted to late Professor W. Szafer, head of the Department of Plant Systematics and Geography, Jagiellonian University, as well as to Professor K. Stecki, head of the Department of General Botany, College of Agriculture in Poznań and to Docent A. Krawiecowa, head of the Department of Plant Morphology and Systematics, B. Bierut University in Wrocław for giving the run of herbaria. The author is also greatful to the Botanical Committee of the Polish Academy of Sciences for partial subsidizing of this work performed in the Department of Plant Systematics and Geography, Warsaw University.

SUGGESTIONS CONCERNING THE MANNER OF HANDLING PILEATE FUNGI FOR IDENTIFICATION

Investigations on fungi, notwithstanding the group, require much patience, care and exactness.

Fruit bodies of higher fungi, particularly *Boletales* and *Agaricales* are undurable, almost ephemeral, rapidly decomposing and readily destroyed by insects. In view of this, they require quick and precise elaboration and troublesome securing in herbaria.

Fruit bodies should be collected very carefully and carried in a basket arranged in a manner preventing squashing, breaking and gathering sand which renders difficult later microscopic studies. They must be collected at various developmental stages, moreover we should dispose of several specimens since single ones sometimes do not allow identification.

The fruit bodies should not be cut but taken out of the substrate with an intact stipe. The investigator should immediately record the abundance of occurrence of individuals, their manner of growth, kind of substrate as well as the surrounding plant community. The data from the observations should be recorded in a notebook. Also observations concerning taste, smell, presence or lack of milk and changes in color should be performed on the site of collecting since frequently these characteristics may be established only in fresh specimens.

Further studies are performed in the laboratory, but the color should be established in daylight. In order to facilitate the recording, various works list the features which should be taken into account. Of course, not all of them may be observed on each specimen, but their lack should also be recorded.

GENERAL NOTES

The following data should be recorded: locality, date of collection, temperature, type and humidity of soil, abundance and frequency of atmospheric fall as well as the description of the vascular plant community. The record should also involve the kind of substrate in which the fungi occur; this substrate should be precisely studied in order to establish whether it consists of humus, excrements, fallen leaves, twigs, cones, slightly decomposed rotten or burnt wood remnants or various organs

of living plants. The mode of growth or occurrence of the specimens found as well as the fact whether the individuals grow singly, dispersed, by several or in groups, clumps or bundles should be noted immediately (Fig. 1).

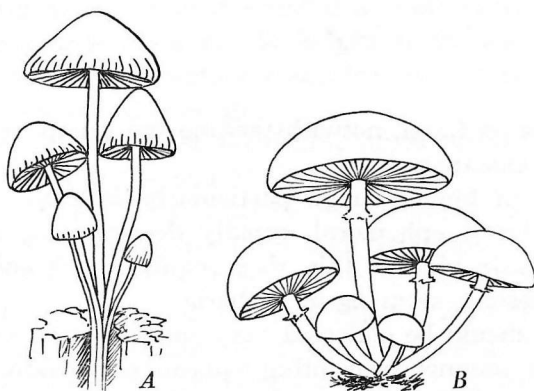


Fig. 1. Group of fruit bodies: A — growing in a bundle; B — growing in a clump.

MACROSCOPIC FEATURES

Pileus. After measuring the diameter and eventually the height (Fig. 2) of the pileus, also the shape (hemispherical, convex, flattened, flat-convex, flat, bullate, umbilicate, depressed, infundibuliform, conical, flabelliform; Fig. 3), type of the tip (obtuse or sharp) and kind of margin should be determined. The margin may be thick or thin, smooth or flexuose, curved, lacerate, involute, incurved, obtuse or revolute, recurved,

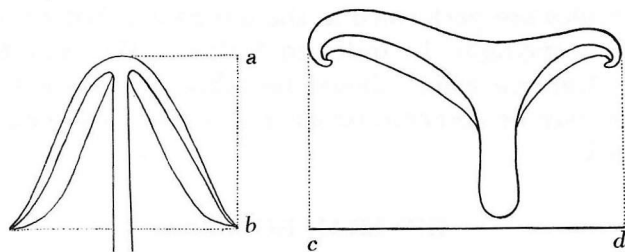


Fig. 2 Pileus: a-b — height, c-d — diameter.

membraneous, translucent; sometimes protruding beyond the hymenophore or fimbriate with remnants of the veil (Fig. 4). The margin of the pileus of some species exhibits shorter or longer bands (particularly visible in water saturated individuals), ribs, furrows, verrucae, flocci, hair or cilia. Also the consistency of pilei should be considered. It may be mem-

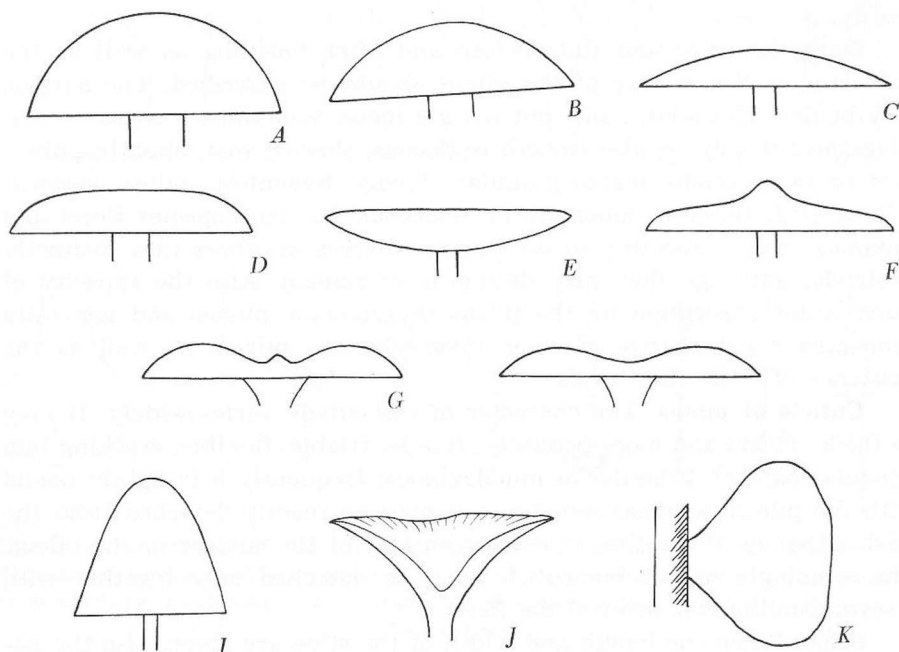


Fig. 3. Various shapes of pileus: A — hemispherical; B — convex; C — flattened; D — flat-convex; E — flat; F — bullate; G — umbilicate; H — depressed; I — conical; J — infundibuliform; K — flabelliform.

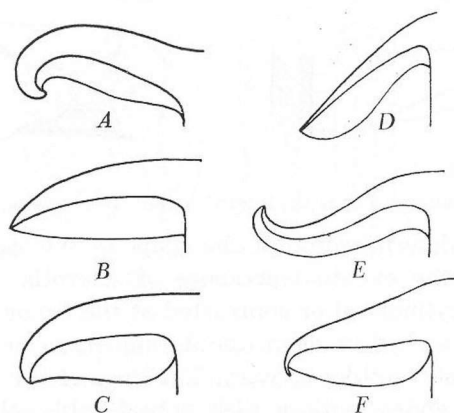


Fig. 4. Various types of margin of the pileus: A — involute; B — obtuse; C — incurved; D — straight; E — revolute; F — protruding.

braneous, fleshy, spongy, tough, friable, fragile, flexible, hard, corky or woody.

Next the color and tints before and after touching as well as the character of the surface of the pileus should be described. The surface may be dry, glutinous, moist but not glutinous, sometimes viscous or mucilaginous; it may be also smooth, sericeous, sheeny, mat, slightly pubescent or to a certain degree granular, downy, tomentose, pilose, cottony, felt or even floccose, squamate or setaceous; in some species flocci and squamae adhere smoothly to the pileus, whereas in others they distinctly protrude; with age they may disappear or remain. Also the capacity of rapid water absorption by the pileus (hygroscopic pileus) and generally connected rapid change of color (hygrophanous pileus) as well as the existence of concentric bands.

Cuticle of pileus. The character of the cuticle varies widely. It may be thick or thin and more precisely, fragile, friable, flexible, cracking into irregular patches, granular or mucilaginous; frequently it is tightly bound with the pileus, whereas sometimes it may be readily detached from the flesh either on the entire or at least on half of the surface of the pileus. The seemingly detachable cuticle may be detached only together with a several-millimeter layer of the flesh.

Stipe. When the length and width of the stipe are given, also the position of the widest part as well as the position of the stipe in relation to the pileus should be taken into account, since it may be central, excentric or lateral (Fig. 5). In the case of the lack of stipe we deal with a sessile fruit body. It should be established whether the stipe may be readily detached from the cap or whether it is strongly connected with the latter.



Fig. 5. Fruit bodies: A — with lateral stipe; B — sessile, without stipe.

In the case of determination of the shape of the stipe we should consider its base and the eventual presence of sclerotia. The stipe may be quite straight and cylindrical or contracted at the tip or at the base; sometimes it is curved, arched or even undulating, more or less twisted, fusi-form, clavate, robust, rootlike or wiry. The base of the stipe is sometimes pilose; it may be ended with a disk considerably elongated acquiring a rootlike shape, somewhat swollen or ended with a distinct bulb (Fig. 6). This bulb may be more or less spherical, streamlined or exhibits a distinct circular edge.

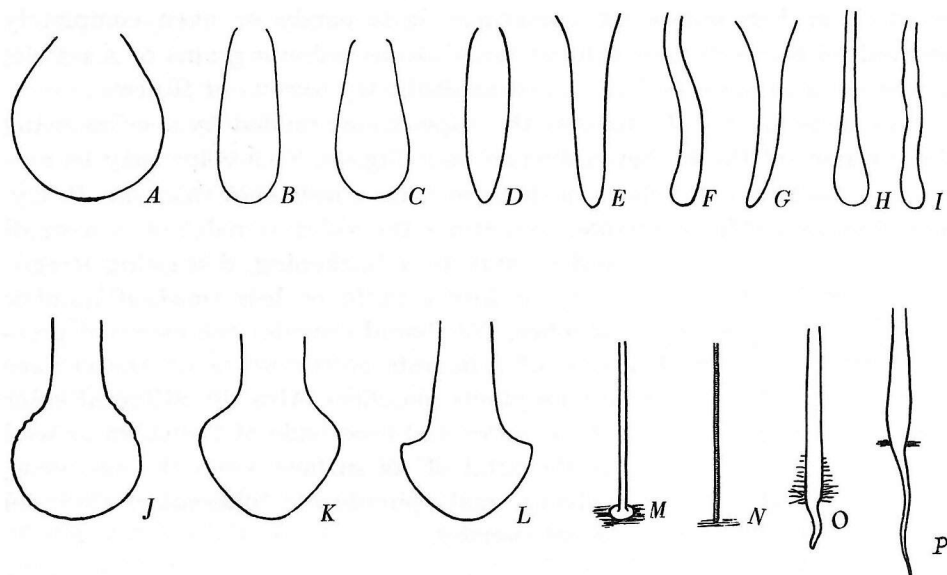


Fig. 6. Various shapes of the stipe and its base: A—rotund; B—cylindrical; C—clavate; D—fusiform; E—widened at the tip; F—curved; G—arched; H—widened at the base; I—flexuose; J—L—bulbous; M—with a disk; N—wiry; O—pilose; P—rootlike.

The internal structure of the stipe, sometimes dependent on the age of the given specimen, is another feature which cannot be omitted in the description. The stipe may be solid, tough, soft or spongy inside, canaliculate, tubular, chambered or completely hollow (Fig. 7). The color, gen-

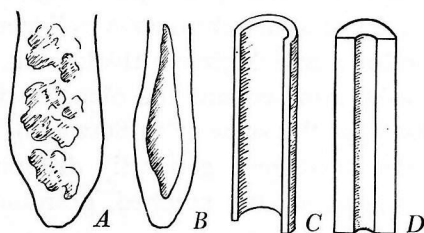


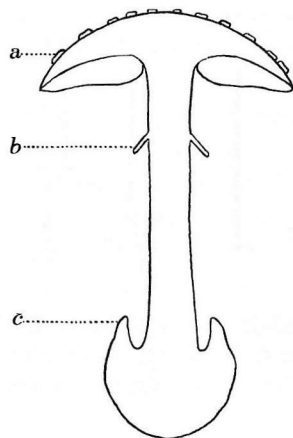
Fig. 7. Internal structure of the stipe: A—chambered; B—hollow; C—tubular; D—canaliculate.

erally varying on various parts of the stipe, is another important characteristic. Generally the color is the most intensive in the central part and sometimes changes when touched. Sometimes the mycelium exhibits a different color than the stipe.

In species provided with a veil we should consider the viscosity of the stipe beneath the annulus. The surface of the stipe may be smooth

or more or less pubescent, sometimes it is partly or even completely covered with colorless or colored liquid drops, minute grains or a reticle; it may be also more or less ribbed or distinctly fibrous or floccose.

In some species the base of the stipe is surrounded by a volva being the remnant of the broken universal veil (Fig. 8). This volva may be ample, narrow, tubular, short or long and its consistency may be fleshy, membranous, thin or friable; sometimes the volva is reduced to a small



roll or only to a thickening, disrupting irregularly or into a more or less constant number of lobes. We should consider the eventual presence of remnants of the volva on the surface of the pileus (patches). Also the different color of the outer and inner side of the volva as well as the kind of its surface (smooth, sericeous, velvety, mat, pubescent, tubercular, floccose) is noteworthy.

Fig. 8. Section through a ripe fruit body of *Amanita* sp.; remnant of universal veil in the form of patches (a) and volva (c), and of partial veil in the form of annulus (b).

The presence or lack of annulus (ring), generally formed from the disruption of the veil of cobwebby or membranous consistency, is an important characteristic. In the case of a cobwebby veil the stipe exhibits a distinct, but sometimes rapidly disappearing, streak instead of the ring, whereas in the case of a membranous veil generally the stipe exhibits a distinct, sometimes mucilaginous thickening, fold or readily visible ring. We should take into account the place of disruption of the veil (at the edge of the pileus, at the stipe or in between), its consistency, color and later surface of the developed, generally dropping, annulus (smooth or fringed, torquate, rugose, striate, notched, granular).

Context. In descriptions of the context (flesh) we should record its thickness and consistency in the pileus and in the stipe (flexible or fragile, friable, compact, tough or soft, spongy, sappy or dry, gelatinous, granular, fibrous, readily perishable or not perishable, hard, pergamenous, corky or woody). The color of the context should be observed not only in the center of the pileus and stipe, but also directly beneath the cuticle and above the hymenophore. Frequently we observe a rapid change in color (or its intensity) even to quite black; in such cases we speak about context of variable color, decolorizing, fading or unchangeable color.

Some species, when damaged, exude colored or colorless sap. When the context is examined, also its taste and smell should be established immediately after collecting. Frequently an objective determination of the smell is difficult. It is advisable to compare it to commonly known more or less strong smells such as those of flour, radish, garlic, hydrochloric acid, herring, sauerkraut, etc. The intensity of the smell may be somewhat increased by placing a cut fruit body in a small glass vessel. After a certain period (one or several hours) we should open it and inhale the smell once or twice slowly.

Also the taste should be established in fresh-collected material by chewing a small piece and tasting it with the tip of the tongue and then removing it from the mouth. Not only the context but also the hymenophore and cuticle should be tasted since the compounds causing various tastes may be concentrated in various parts of the fruit body. Here are several examples for the determination of the intensity and kind of taste: strong, weak, slight, acrid or astringent, bitter like quinine, stinging, peppery, unpleasant, sour. The intensity of the taste may vary in young and old specimens as well as in those collected during rain or in the course of long-lasting drought.

Lamellae. A lamellate hymenophore should be examined after a longitudinal section. We can observe the density of lamellae (densely or sparsely arranged), their thickness, width (narrow, wide, rudimentary, in the form of folds) as well as the presence of shorter lamellae (lamellulae) between those normally reaching the stipe, their number and shape. We should consider also the ramifications (bifurcate, ramified, simple) and connections at the bases of lamellae (anastomosing, ribbed, veinous, rugose, plicate).

The description of lamellae should include their position in respect to the stipe. They may be free, adnate, sinuate, decurrent, rounded, provided with a tooth

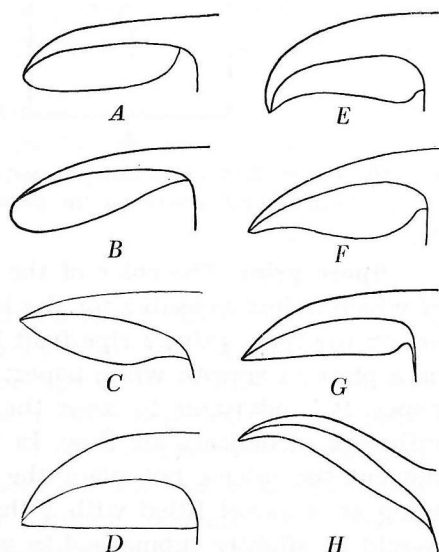


Fig. 9. Arrangement of lamellae in respect to the stipe: A—distant; B, C—free; D—adnate; E, F—sinuate; G—sinuate with a tooth; H—decurrent. Various shapes of lamellae: B—widened in the frontal part; C—contracted at both ends; F—widened in the back part; C, F—ventricose; H—arched.

prolonged onto the stipe. Also if possible, we should indicate the shape of lamellae, e.g., arched, contracted on both ends, widened at the frontal part, undulated, ventricose (Fig. 9).

It should be recorded whether the lamellae are flexible, stiff, friable, waxy, smooth or rough. Also we should establish whether the lamellae may be hardly or easily detached from the context of the pileus (e.g., in *Paxillus involutus*). Further, their color (in young, ripe and old fruit bodies) should be described when looking at it from one side. Sometimes we can observe mottled or spotted lamellae or minute liquid droplets exuded at young age.

Also the edge of lamellae (gills) should be described. They may exhibit the same or a different color as the lamellae, moreover they may be sharp or blunt, thick, smooth, obtuse, lacerate, dentate, tomentose, granular, brushlike, serrate.

Tubes. Most features mentioned for lamellae also pertain to the tubular hymenophore. We should not describe a single tube, but a certain fragment of the hymenophore. Thus, we should consider the outer side of the hymenophore called by mycologists "pores," we should describe its color, measure in ripe specimens the diameter of pores and determine their shape (circular, oval, elongated, simple, complex, angular, regular, irregular, labyrinthine) and describe their edge — smooth or dentate.

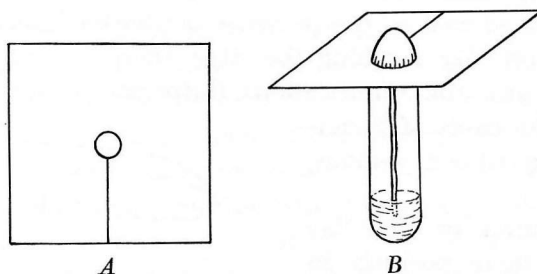


Fig. 10. A — method of cutting the paper to be placed under pileus; B — method of fixing small pileus on the paper. End of stipe submerged in water.

Spore print. The color of the spore print is a feature the knowledge of which is indispensable for the identification of many fungi. In order to obtain the spore print a ripe fruit body or only its pileus should be placed on a piece of smooth white paper; the hymenophore should adhere to the paper. It is advisable to cover the pileus with a bell glass to prevent the influence of delicate air flow. In the case of small specimens we should not cut the pileus, but place the entire fruit body on a piece of paper lying on a vessel filled with a thin layer of water; the end of the stipe should be slightly submerged in water (Fig. 10). This procedure prevents

the small fruit body from excessive drying and the consequent stop of sporulation.

After one or several hours, in dependence on the intensity of sporulation, the pileus is carefully removed, the paper with spores is dried and the color of spores is determined either in words or according to a scale of colors or by means of painting of a small square on the paper. Further, the paper with the spore print should be placed in a little envelope and enclosed with the pertaining specimen in the herbarium.

MICROSCOPIC FEATURES

A magnifying glass, microscope, preparation instruments as well as reagents are indispensable for studies of microscopic features.

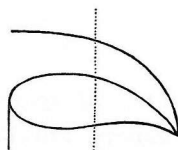
At least two sections of a fruit body should be performed: vertical section — through the entire fruit body from its tip to the base, and cross section — through the center of the stipe.

After recording the macroscopic features, we prepare microscopic cuttings of the pileus, stipe and hymenophore. A thin cutting from the pileus surface (scalp) and from the stipe are indispensable. Such a cutting should be made crosswise to the surface and placed on an object glass with the sectioned side against the glass. Cuttings of the stipe surface are prepared analogously. Then we can establish the presence of pigment, cystidia and veil. A cutting made vertically to the pileus surface allows to observe the structure of the cuticle. Sections should be performed at mid distance from the tip to the pileus margin.

The section through lamellae may be performed through a single or several lamellae perpendicularly to the pileus surface and to the surface of the lamella (Fig. 11).

Basidia. We should measure the length (without sterigmata) and width of the basidium in the thickest point, perform its outline, establish the number of ste-

Fig. 11. Line (dashed) of sectioning of lamella for preparation of microscopic cutting.



rigmata (two-, three-, four- or five-spore basidia), their position on the basidium and their shape (short, long, straight, arched, thin, thick).

Spores. We should outline the ripe spores in profile and en face, measure their length and width and record the dimensions giving extreme ones in parenthesis as follows: (5-) $6-8 \times 11$ (-15) μ . Then we should establish the shape of spores (beanlike, cylindrical, allantoid, almondlike, lemonlike, ellipsoidal, narrowed, fusiform, globose, obovate, wide-obovate, stonelike, rhomboidal, provided with a spur or nodule; Fig. 12).

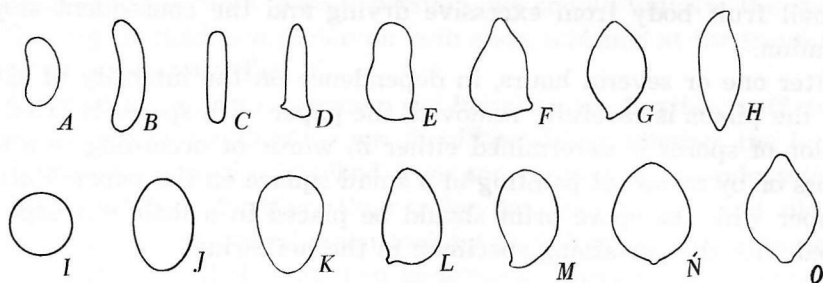
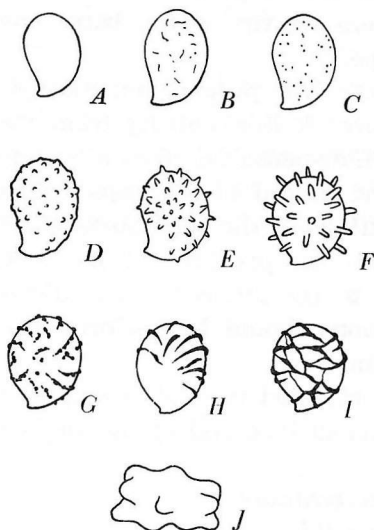


Fig. 12. Shape of spores: A—reniform; B—allantoid; C—cylindrical; D—with a spur; E—contracted in the center; F, N—with a nodule; G—rhomboidal; H—fusiform; I—globose (spherical); J—ellipsoidal; K—obovate; L—almondlike; M—stonelike; N—wide-obovate; O—lemon-shaped.



Also the size of the apiculus, the presence of the hilum and its situation (terminal or lateral) as well as the thickness and relief of the wall (smooth, rough, granular, verrucose, aculeate, echinate, nodulous, beady, crested, winged, ribbed, reticulate; Fig. 13) should be established. Further we should establish the eventual presence of a baldness or spot near the apiculus (or hilum; Fig. 14) In some cases a stable number of distinct, large drops are visible within the spores. Also the amyloid char-

Fig. 13. Surface of spores: A—smooth; B—rough; C—punctate; D—verrucose; E—aculeate; F—echinate; G—beady; H—crested; I—reticulate; J—nodulous.

acter of spore walls should be tested; under the influence of Melzer's reagent amyloid spores change color, mostly to gray, e.g., in *Amanita rubescens* (spores of *Amanita muscaria* are nonamyloid).

Cystidia. The presence or lack of cystidia as well as their abundance, depth of setting in the trama of lamellae, dimensions (from tip to base) and shape (elongated, pointed, cylindrical, lanceolate, clavate, ampullaceous, vesicular, capitate, ramified, brushlike, with a stalk; Fig. 15) should be established. Also the color and thickness as well as the eventual relief or kind of incrustation should be recorded.

In dependence on the place of their occurrence cystidia may be divided into the following four groups: pleurocystidia occurring on the

surface of lamellae or within tubes, cheilocystidia developing on the edge of lamellae or on the margin of pores, pilocystidia occurring on the surface of the pileus, and caulocystidia developing on the surface of the stipe, mainly on its upper part.

Fig. 14. Plaque on the spore: A — from the profile; B — from the ventral side.

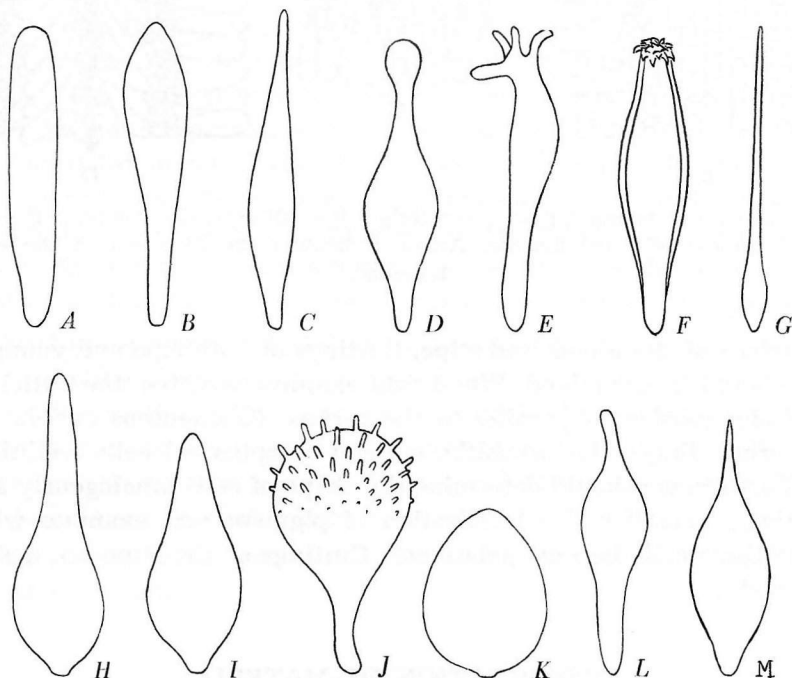
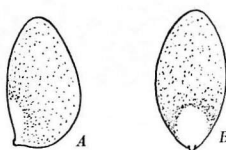


Fig. 15. Shape of cystidia: A — cylindrical; B — clavate; C — elongated and pointed; D — capitate; E — ramified; F — incrusted; G — setaceous; H — ampullaceous; I — lanceolate; J — brushlike; K — vesiculose; L — stalked; M — with a process.

Trama. The trama should be examined on the section of lamellae perpendicular to their surface and to that of the pileus. We should observe the arrangement of its hyphae, the dimensions of cells and their shape (cylindrical, oval, narrowed, roundish, etc.). The trama can be filiform, cellular or tangled, bilateral or inverse (Fig. 16). We should record the presence or lack of clamps or sap hyphae. Clamp connections should be detected in fruit bodies or in mycelia at the stipe base.

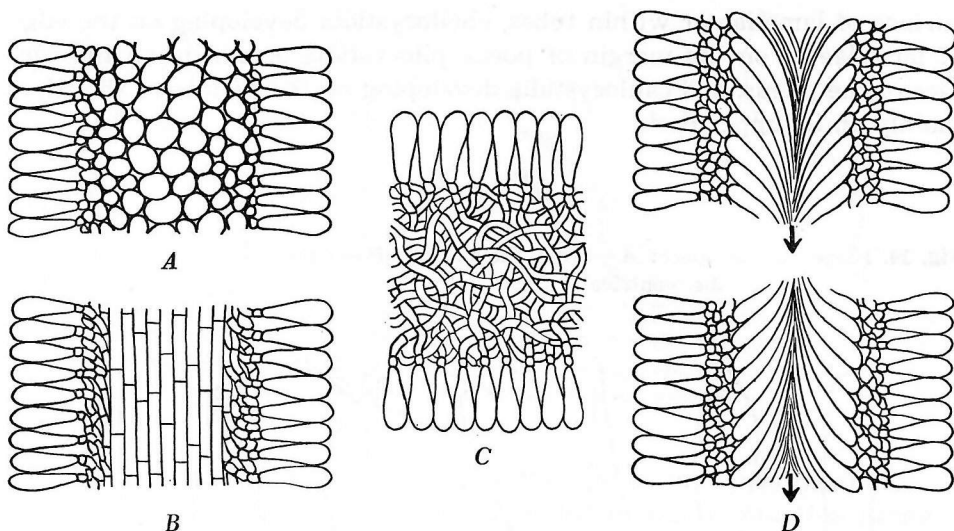


Fig. 16. Scheme of frame types: A — cellular; B — filiform; C — tangled; D — below: bilateral, above: bilateral inverse. Arrow indicating the direction of the edge of lamellae.

Surface of the pileus and stipe. Cuttings of both ripe and young fruit bodies should be examined. We should examine whether the cuticle consists of elongated cells parallel to the surface (filamentous cuticle), elongated, protruding cells (brushlike cuticle) or spherical cells (cellular cuticle). Further, we should determine the shape of cells (analogously as that of cystidia), establish the localization of pigment and examine whether some of these cells become gelatinous. Cuttings of the stipe are described analogously.

PRESERVATION OF MATERIAL

After elaboration and description, performance of drawings and identification, the material should be preserved in a way enabling its use for comparative purpose.

Fleshy fungi can be preserved in fluid or in dry. The former method is troublesome since it requires many, hermetic vessels. In some cases, however, particularly in histological studies, this method is very useful. The following solution is recommended here:

alcohol	95 percent	— 100 cu cm
formalin	40 percent	— 10 cu cm
glacial acetic acid		— 5 cu cm

This solution can be supplemented with 20 cu cm of distilled water. In the case of very sappy fungi the fluid should be changed after several days.

The preservation of collected material in dry in the form of a herbarium is considerably more troublesome in the first period. The fungal specimens for preservation should be carefully selected (ripe and young individuals of a single species) and the sand should be removed delicately. We should avoid maceration of the fungus by touching it with fingers in various places since this can cause destruction or damage of tubercles, granules or reticles.

Small specimens are generally dried wholly whereas large ones are cut, for instance into four pieces, in view of the duration of the process of drying. The fungi should be dried at temperatures not exceeding 40°C since at higher temperatures the drying is too abrupt and destroys the cells. The dried material should be situated in respect to the source of heat so as to enable the removal of accumulating vapor with the air flow. It is advisable to employ a thermostat but the fungi can be dried, particularly in field studies, on a kitchen oven or even in the open air in an airy place on blotting paper (bound, but not pressed to one other).

The dried specimens should be placed in small envelopes (analogously as medical pills), their spore print should be enclosed and a label should be stuck to the envelope. The envelopes should be kept in cardboard boxes or filing jackets having the following dimensions: 21×30 cm or 28×45 cm. A single genus or single species should be placed in an individual jacket. These jackets are generally kept in boxes.

The fungal herbarium should be disinfected since frequently it is attacked by insects.

REAGENTS

A stable set of most important reagents should be prepared for microscopic studies of fungi belonging to the orders *Boletales* and *Agaricales*.

In practice it is advisable to use water during the first review of cuttings and only later a suitable reagent should be employed in dependence on the problem at hand. If we want to obtain a macrochemical reaction it remains to place a drop of the reagent onto the given part of the fruit body with a pipette or a glass rod.

Formalin — 40 percent aqueous solution of formaldehyde is used for macroscopic reactions.

Sodium hydroxide, NaOH — 30–50 percent aqueous solution, mainly used to obtain staining macroscopic reactions and 5–10 percent solution — for rapid swelling of cuttings obtained from herbarium material (occasionally deformations occur). A 2 percent solution applied for 5 min is suitable for spores.

Potassium hydroxide, KOH — as above.

Ammonia, NH_3 (also NH_4OH) — aqueous solution — for swelling of cuttings obtained from dried material; owing to it the material regains its natural appearance. Sometimes it facilitates the observation of the relief of spores. Ammonia should be kept in small amounts in vessels with tight corks and should be frequently changed since only ammonia which cannot be inhaled is a good reagent.

Ferrous sulfate, FeSO_4 — 10 percent aqueous solution is used for obtaining macroreactions. This reagent rapidly goes bad.

Sulfovanillin — stains the content of cystidia and sap hyphae in the representatives of family *Russulaceae*.

distilled water	2 cu cm
95 percent sulfuric acid (chemically pure)	2 cu cm
vanillin	0.25 g

The solution must be transparent and protected against light; it is advisable to prepare it directly before its use by dissolving several vanillin crystals in a large water drop with the acid.

Sulfoformalin — application similar as that of sulfovanillin.

distilled water	1.5 cu cm (about 25 drops)
60–70 percent sulfuric acid (chemically pure)	5 cu cm
40 percent formalin	4 cu cm

Congo red — ammonia solution used for swelling of cuttings and simultaneous staining of walls.

Congo red	very small amount, e.g., 0.1 g
ammonia	20 cu cm

The solution should exhibit a color of red ink. It should be refreshed when ammonia evaporates.

Chloral hydrate — aqueous solution mainly used in microscopic studies on herbarium specimens since it makes their color lighter and causes swelling. It is advisable to prepare it directly before use: two water drops on a preparation glass should be supplemented with an almost equal (or smaller) volume of chloral hydrate crystals.

Melzer's reagent — indispensable in every mycological laboratory. It causes swelling, allows to detect amyloid walls of spores (staining them blue, gray or black) and perfectly demonstrates the relief of amyloid spores. The amyloid character may be best observed on a glass on a small

fragment of the spore print to which a drop of the reagent is added. The reagent should be stored in chromium glass vessels.

potassium iodide	1.5 g
iodine	0.5 g
water	20.0 g

Chloral hydrate crystals should be added to the I+KI solution in a 1 : 1 weight proportion. Josserand advises to do it twice a year.

Acids: hydrochloric (HCl), nitric (HNO₃), sulfuric (H₂SO₄).

Sweetened water — aqueous solution of saccharose, up to 8 percent and exceeding 12 percent for causing plasmolysis in cases of doubts with regard to the localization of pigment.

Lactic blue — 0.1 percent solution of acidic aniline blue (bleu coton) in lactic acid; it should be used either pure or in a 1 : 1 aqueous solution. When a cutting is boiled in a drop of this reagent the cell content is stained.

FEW REMARKS ON EDIBLE AND POISONOUS SPECIES

Of all the orders of pileate fungi *Boletales* include most edible and valuable species in Poland. Here belongs in the first place *Boletus edulis* and further — *Xerocomus badius* and *Gyroporus castaneus*. They are utilized fresh, dried or pickled (youngest specimens). *Suillus granulatus* and *S. luteus*, less frequently *S. grevillei* are sought for immediate utilization or for pickle production. Various *Leccinum* species are consumed only fresh boiled. All the *Boletales* species with a context growing blue or with red pores are popularly regarded as suspected or poisonous (though in the mountains, e.g., *Boletus erythropus* is known as an edible and valuable fungus). In view of the growing interest in edible fungi recently the Ministry of Health allowed for sale some of the species belonging to the order *Boletales*.

ORDER BOLETALES

Pileate fungi mostly with robust, fleshy, perishable, readily rotting fruit bodies; fruit bodies consisting of pileus and centrally developed stipe; in some species stipe excentric or completely lateral. These fungi generally develop on the ground, less frequently on rotten wood.

Hymenophore tubular, less frequently lamellate; in most cases readily detachable from the context. Tubes forming the hymenophore more or less easily separable from each other, adnate, sinuate or decurrent; lamellae invariably decurrent.

Fungi with lamellate hymenophore characterized by the presence of glutinous (less frequently cobwebby) universal veil or lamellae more or less anastomosing at their base. Veil occurring also in tubular fungi.

Spore print of various color. Spores smooth, fusiform, ellipsoidal or roundish but then reticulate. Basidia usually four-spored.

Fungi belonging to the order *Boletales* occur all over the world and their number exceeds 200 species.

The order *Boletales* is a systematic unit grouping closely related representatives of the families *Boletaceae*, *Strobilomycetaceae*, *Gomphidiaceae* and *Paxillaceae*. Fungi belonging to these families constitute intermediate forms between *Agaricaceae* and *Polyporaceae* and exhibit (*Strobilomycetaceae*) certain relations with *Gasteromycetes*.

Recently, many authors represent the opinion that the intermediate character of these fungi provides insufficient grounds to keep a separate order. This opinion is manifested in systematics in which the families mentioned above are classified to the order *Agaricales*.

REVIEW OF FAMILIES

1. Hymenophore consisting of more or less shallow depressions or pores due to the undulation of the pileus surface. Fruit bodies diffuse, never pileate see: *Meruliaceae*.
- 1*. Hymenophore tubulate, less frequently lamellate. Fruit bodies do not diffuse, most frequently of definite shape 2.
2. Fruit bodies woody or corky, sometimes fleshy, wood inhabiting, with lateral pilei generally without stipe, or overground

- with pilei on stipes. Tube layer sometimes very thin, about 2 mm, difficult to separate from the pileus context 3.
- 2*. Fruit bodies invariably fleshy, with pilei on stipes, generally overground. Tubes accreting to each other; in most cases context easily separable from the pileus. Sometimes hymenophore lamellate 4.
3. Fruit bodies without bloodlike sap see: *Polyporaceae*.
- 3*. Fruit bodies with red sap. Tubes not accreting laterally to each other see: *Fistulinaceae*.
4. Hymenophore tubulate; occasionally lamellate, but then with very many anastomoses 5.
- 4*. Hymenophore lamellate 6.
5. Spore smooth *Boletaceae*, p. 21.
- 5*. Spore reticulate *Strobilomycetaceae*, p. 97.
6. Overground fungi with glutinous or tomentose universal veil. Stipe generally central. Lamellae thick, decurrent, when ripe almost black. Spore print olive-black or completely black *Gomphidiaceae*, p. 107.
- 6*. Overground or wood-inhabiting fungi deprived of universal veil; lamellae thin, more or less anastomosing at their base or near the stipe, decurrent; margin of pileus involute. Spore print ochre *Paxillaceae*, p. 100.

FAMILY BOLETACEAE

Pileus from 2 cm (small) to 20 cm or even more (large) in diameter, mostly thick and robust; its surface tomentose or velutinous, floccose, fibrous, granular, furfuraceous, mat; in some species pileus smooth, shiny, dry or glutinous; sometimes slightly tessellate; invariably nonhygrophanous. Stipe central, exceptionally excentric, 3–15 cm high, 0.5–7 cm thick, smooth, covered with minute grains or delicate relief in a form of minute reticle; sometimes distinctly fibrous and then covered with numerous flocci; solid, rarely hollow or pithy. Shape of stem slightly varying; cylindric, attenuate or thickened toward the base, swollen in the central part, less frequently contracted at the base or somewhat bulbous. Partial veil observed in some species. Veil generally membranaceous, membranaceous-floccose, glutinous, sometimes appearing as powdered; with advancing age either completely disappearing or remaining in the form of an annulus on the stipe.

Context white, pinkish, cream or yellow to brown with various tints,

after breaking, color either unchanged or light blue, dark blue, greenish, gray, less frequently pink to sordid lilaceous. Taste generally mild, sometimes bitter and stringing. Smell generally agreeable. Tubes short (from 2 mm) to long (2 cm), indented, adnate to the stipe or decurrent, white-yellowish, lemon, olive, green, brown, pink, red, frequently darkening by exposure; in most cases readily separable from the context. Pores circular to angular with strongly undulated margin, mostly of brighter color than tubes, sometimes lateritious or vivid red; sometimes when pressed changing color to sordid olive, greenish, navy blue or scarlet.

Spore print white-cream-yellow, ochreous, lemon, olive, olive-brown, pink or dark scarlet. Basidia four-spored. Cystidia frequently present. Spores smooth, more or less fusiform, less frequently ellipsoidal, 5–22 μ long and 3–8 μ wide.

Representatives of this family form fruit bodies generally living up to two weeks, overground, but rarely developing on decayed wood, in cortex crevices, at tree butts; as parasites they occur on fruit bodies of fungi of the genus *Scleroderma*. A great majority of *Boletaceae* form mycorrhiza in symbiosis with forest trees. The fleshy fruit bodies of many species are used as food and owing to this are collected in masses. Some of them are poisonous or inedible in view of their bitterness. Over 110 species belonging to this family occur all over the world.

Some authors classify the representatives of the family *Strobilomycetaceae* to *Boletaceae* as a subfamily; whereas in the opinion of others the distinction of this family is completely justified.

KEY TO THE GENERA

1. Hymenophore lamellate with numerous anastomoses see *Paxillaceae*, p. 100.
- 1*. Hymenophore tubulate 2.
2. Spore print cream-white *Gyroporus*, p. 25.
- 2*. Spore print pale pink *Tylopilus*, p. 83.
- 2**. Spore print of another color, mostly more or less olive 3.
3. Tubes of ripe fruit bodies short, 2–4 mm long, strongly adhering to the pileus, decurrent (compare also the family *Polyporaceae*) *Gyrodon*, p. 24.
- 3*. Tubes of ripe bodies invariably over 5 mm long 4.
4. Stipe hollow, provided with an annulus. If stipe solid, then pileus with reddish squamaelike flocci and growing on

- habitats near Douglas spruce. Pores very large, angular *Boletinus*, p. 28.
- 4*. Stipe invariably solid, at the utmost pithy. Pore of varying size. If large, angular, then stipe without annulus 5.
5. Stipe distinctly fibrous, floccose, rough. Pores minute, white, when ripe — gray to sordid brown. Spore print never brown-scarlet *Leccinum*, p. 84.
- 5*. Stipe more or less fibrous; pores gray, when ripe — sordid olive; ripe tubes — sordid brown, becoming pink or red when exposed. Spore print brown-scarlet see *Strobilomycetaceae*, p. 96.
- 5**. Stipe not fibrous. Pores of ripe fruit bodies of a different color. Spore print not brown-scarlet 6.
6. Pileus glutinous (smooth and shiny in the course of drought) or less sticky or even floccose (*Suillus variegatus*). Stipe sometimes provided with annulus *Suillus*, p. 32.
- 6*. Pileus mat, dry, more or less tomentose. Stipe invariably without annulus 7.
7. Stipe robust, often bulbous, reticulate, granular or quite smooth (*Boletus queletii*). Ripe pores yellow, olive or red *Boletus*, p. 60.
- 7*. Stipe cylindric, not swollen, smooth. Pores only exceptionally red (*Suillus rubinus*) 8.
8. Mycelium golden-yellow. Pileus sulfur-yellow or yellow-brown to ferruginous-golden *Pulveroboletus*, p. 57.
- 8*. Mycelium whitish. Pileus deprived of golden or sulfur color *Xerocomus*, p. 49.

Genus *Gyrodon* Opat.

Gyrodon Opat., Comm. Hist.-Nat. Fung. Bolet., Wiegmann's Arch., 2(1):5, 1836.

Pileus almost smooth, somewhat floccose, during rain slightly glutinous. Stipe central, frequently excentric, less frequently lateral, smooth, solid. Veil none. Context with variable color (in European species). Tubes very short, strongly adhering to the pileus. Pores irregular, labyrinthine.

Spore print ochre-brown. Spores short, ellipsoidal or somewhat reniform, smooth. Cystidia at pore margins. Hyphae with clamps.

Fungi belonging to this genus occur on the ground or on wood; frequently they form mycorrhiza with some deciduous trees.

Individual species are known on both hemispheres. Some of them are edible but not utilized as food. Hitherto eight species have been described, only one of which has been found in Europe.

1. *Gyrodon lividus* (Bull. ex Fr.) Sacc.

Boletus lividus Bull. ex Fr., Syst. Mycol., 1:389, 1821. — *Gyrodon lividus* (Bull. ex Fr.) Sacc., Syll., 6:52, 1888.

Boletus sistotrema Fr., Syst. Mycol. 1:389, 1821, non Rostk. in Sturm. — *Gyrodon sistotremoides* Opat., Comm. Hist.-Nat. Fung. Bolet., Wiegmann's Arch. 2(1):5, 1836. — *Boletus rubescens* Trog., Flora 22(2):449, 1839. — *Boletus lividus* (Bull. ex Fr.) Sacc., Syll. 6:52, 1888.

Pileus 4–20 cm in diameter, slightly convex, rapidly becoming flat and more or less depressed, with a margin in young age somewhat involute. Surface of pileus sericeous or tomentous, sometimes slightly floccose, less frequently smooth, during rain even sticky, gray, yellow, lemon with gray to light brown and ferruginous shade. Cuticle when touched becomes slightly brown, sometimes it may be partly peeled off. Stipe rather slim, widening at the tip, 3–12×0.5 cm, smooth, at the tip slightly ribbed, of almost identical color as the pileus. Mycelium at its base gray-yellowish. Context relatively soft, cream-yellow, yellow-flesh colored, buff under the cuticle, in the stipe slightly brown but darkening with age to ferruginous, becoming light blue, particularly under tubes, by exposure. Smell weak, taste sourish. Tubes short, on average 0.3 cm, rarely up to 0.6 cm, nonseparable from the pileus, arcuate decurrent, pale yellow, with advancing age lemon-yellow, yellow-olive, olive-brown. When touched becoming blue-greenish and later brown. Pores, when young, yellowish, later sulfur-yellow, yellow-olive. When touched, becoming blue-green and later sordid brown. When young of very irregular shape, labyrinthine, later radially elongating toward the center of the pileus. Margin of pores sometimes ended with teeth.

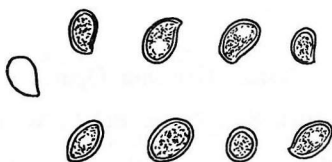


Fig. 17. Spores of *Gyrodon lividus* (Bull. ex Fr.) Sacc. (×1000).

Spore print ochre with an olive tint. Spores short, ellipsoidal, frequently with a single drop, 4–8×3–5 μ (Fig. 17). Basidia yellowish, 18–35×5–10 μ . Cystidia colorless or yellowish, cylindric-fusiform, agglomerated at the margin of pores, 26–48×6–10 μ . Hyphae with clamp connections.

Habitat. It occurs singly or in clumps consisting of several individuals on the ground or on rotting trunks, on humid sites, on forest clearings, near streams, in light mixed forests (with alder), both on lowlands and in the mountains. It has been

found at 1100 m a.s.l.* (Dalla Torre, see Kallenbach; and about 1500 m a.s.l., see Singer, 1965). August–October.

Distribution in Poland. Rare. Hitherto found near Poznań, Warsaw, Myślenice, Gdynia, Szczecin and Elbląg, in Silesia and in Zielona Góra Voivodship (Lubuska Region).

General distribution. Mainly in Europe.

Notes. Edible.

This species is an intermediate from rather distinctly connecting the orders *Boletales* and *Aphylllophorales*. Characteristic features: stipe generally excentric, not perishable, tubes labyrinthine, very short, decurrent nonseparable from the context of the pileus. — Plate 1, 1–3. — Kallenbach, Table 39.

Genus *Gyroporus* Quél.

Gyroporus Quél., Enchir., p. 161, 1886, emend., Pat., Ess. tax., p. 124, 1900.—*Suillus* Karst., Bidr. Finl. Nat. Folk, 37:v, 1882, non S.F. Gray (1881).

Pileus dry, smooth, somewhat tomentose or felty and fibrous-floccose, sometimes slightly areolate, friable, fragile. Cuticle nonseparable from the context. Stipe solid, with soft interior, with advancing age pithy and hollow, with a smooth surface, without grains or reticle. Veil none. Context white or cream-yellow, unchanging or becoming slightly blue by exposure (containing no boletol). Tubes moderately long, about 0.8 cm, indented, white or yellowish in European species. Pores minute, circular, initially closed.

Spore print cream-yellow. Spores elliptical in outline. Basidia cylindric-clavate, Cystidia within tubes or near pores. Hyphae with clamp connections.

Representatives of the genus *Gyroporus* occur in coniferous and deciduous forests as well as on open areas far from any trees. Often under certain conditions they form mycorrhiza. A total number of 9 species is known in both the temperate and tropical zones. All of them are edible and valuable.

KEY TO THE SPECIES

1. Pileus maroon. Context invariable *G. castaneus*, p. 26.
- 1*. Pileus straw-yellow. Context turning bluish
. *G. cyanescens*, p. 27.

*Note: abbreviation a.s.l. means above sea level and is used throughout the work.

1. *Gyroporus castaneus* (Bull. ex Fr.) Quél.

Boletus castaneus Bull. ex Fr., Syst. Mycol., 1:392, 1821. — *Suillus castaneus* Poir. in Lam. ex Karst., Bidr. Finl. Nat. Folk, 37:1, 1882. — *Gyroporus castaneus* (Bull. ex Fr.) Quél. Enchir., p. 161, 1886.

[*Boletus fulvidus* Fr., Obs. Mycol., 2:247, 1818].

Pileus 6–12 cm in diameter, fleshy, very convex but with advancing age flattened, maroon, cinnamon, occasionally in some points yellowish, dry, mat, pubescent, rarely quite smooth (occasionally, particularly during drought, cracking into small irregular patches), tough, friable and fragile. Cuticle nonseparable from the context. Stipe 5–7×2–3.5 cm, felty similarly as the pileus, cylindric, occasionally slightly swollen toward base, initially solid, with advancing age spongy and further hollow, with numerous chambers frequently joining in a single niche; external layer compact and relatively hard. Color of stipe identical or at apex somewhat lighter than that of the pileus. Context very compact, tough but friable, within the stipe in older specimens spongy, white, only directly under the cuticle of the pileus and stipe ferrugineous, color invariable. Taste and smell agreeable. Tubes almost free or sinuate, moderately long, on average 0.5–0.8 cm, white, with age becoming yellow. Pores minute, obtuse, with smooth edges, of identical color as tubes.

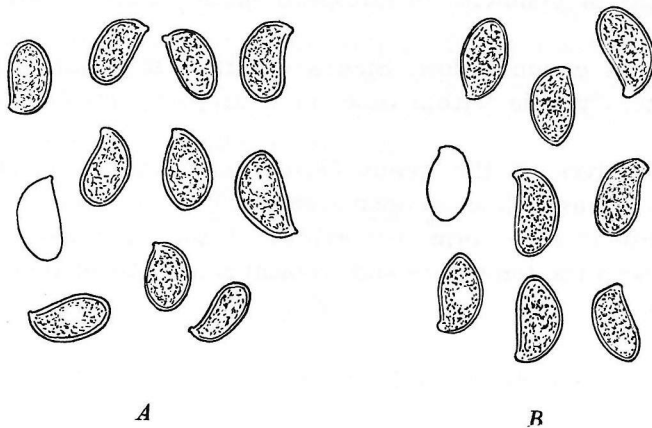


Fig. 18. A — spores of *Gyroporus castaneus* (Bull. ex Fr.) Quél.; B — spores of *G. cyanescens* (Bull. ex Fr.) Quél. (×1000).

Spore print white-cream to light yellow. Spores ellipsoidal, sometimes slightly curved and asymmetric, smooth, with fine-grained content, $8\text{--}12 \times 5\text{--}6.3 \mu$ (Fig. 18, A). Basidia $27\text{--}42 \times 9\text{--}12 \mu$. Cystidia occurring mainly on the margin of tubes, colorless, clavate or swollen in the center, $35\text{--}50 \times 7\text{--}15 \mu$.

Habitat. It occurs singly or in small groups in light deciduous and mixed forests, on margins of forest cultures, on balks and other open areas, on light and sandy soils. Most frequently found beneath oaks. According to some authors it avoids calcareous soils. July-October.

Distribution in Poland. It occurs all over the country, though, it does not belong to the most common species.

General distribution. Europe, Asia, northern Africa, Australia?, North America.

Notes. Edible, savory, in spite of slight bitterness when cooked estimated as valuable as *Boletus edulis*.

This species is characteristic and may be readily identified by the maroon pileus and stipe as well as by the invariable, white context and mostly hollow stipe. — Plate 2 — Konrad et Maublanc, 394.

3. *Gyroporus cyanescens* (Bull. ex. Fr.) Quél.

Boletus cyanescens Bull. ex Fr., Syst. Mycol., 1:395, 1821. — *Suillus cyanescens* Poir. in Lam. ex Karst., Bidr. Finl. Nat. Folk, 37:1, 1882. — *Gyroporus cyanescens* (Bull. ex Fr.) Quél., Enchir., p. 161, 1886.

Pileus 5–15 cm in diameter, fleshy, tough, fragile, convex, with age somewhat flattened, dry, mat, floccose, light cream-yellow, yellowish, ochre, becomes bluish when touched. Stipe 2–8×5–4 cm, cylindric, thicker at the base, initially solid, with age spongy, finally hollow, sometimes divided into chambers. Externally compact, hard, but friable and fragile; smooth and whitish at the tip, concolorous with the pileus at the base, becoming bluish when touched. Context compact, tough, friable, white or light-cream-yellow, when exposed immediately turning light blue. Taste agreeable. Smell slight. Tubes almost free or sinuate, about 1 cm long, white, later light-cream-yellow, turning bluish by exposure. Pores minute, circular or wide-oval, white, with age yellowish, turning bluish when touched.

Spore print white-cream-yellow. Spores ellipsoidal, asymmetric, with fine grained content, smooth, 8–13(–14)×5–7 μ (Fig. 18, B). Basidia 11–14×5–7 μ . Cystidia colorless, clavate, developing more abundantly near pores, 35–50×8–10 μ .

Habitat. It occurs in light mixed forests on sandy soils. June–October.

Distribution in Poland. Its occurrence was observed on vast areas of Poland: in Lublin, Kielce, Cracow, Warsaw voivodships, in the Masurian Lakes, in Podlasie Region, in Poznań Voivodship as well as on the Baltic coast and in Silesia. It is frequently found.

General distribution. Europe, Asia, North America.

Notes. Edible and tasty. This fungus can be readily identified by its light, straw-yellow, dry pileus, similarly light pores and stipe as well as by its context growing light blue. Watling distinguished in 1969 an American variety *violaceotinctus*; it differs from the typical var. *cyanescens* by the color of its context, which in both the pileus and the stipe becomes dark lilaceous or rich purple to deep blue. — Plate 1, 4–5. — Konrad et Maublanc, 393.

Genus *Boletinus* Kalchbr.

Boletinus Kalchbr., Bot. Zeitschr., 25:182, 1867.

Pileus fibrillose, floccose or even squamose, dry (in some extra-European species viscid). Veil invariably present. Stipe provided with a not always persistent annulus. Tubes tightly adhering to the pileus, decurrent, with large, radially elongated pores.

Spore print ochre with olive tint. Spores more or less elongated, fusiform, obtuse. Cystidia clavate.

Fungi belonging to this genus develop on the ground, less frequently on wood, in forests and on open areas, but invariably near coniferous trees with which they form mycorrhiza. They occur on the North Hemisphere in the temperature and boreal zone, whereas a single species—in the subtropical zone. A total number of 13 species, three of them in Europe, have been, hitherto, described. Edible, but not very tasty.

Some fungi belonging to this genus sometimes exhibit gasteromycetoid forms the fruit bodies of which do not open but remain closed with a veil. They are pear-shaped. The tip of the stipe consists of a kind of columella, the hymenophore forms labyrinthine chambers whereas their pileus resembles a peridium. Their spores are normal. According to some authors the existence of such forms points to certain relations between the representatives of *Boletaceae* and *Gasteromycetes*.

KEY TO THE SPECIES

1. Hyphae invariably with numerous clamp connections (subgenus *Boletinus* Sing.). Stipe hollow (section *Boletinus*) in European species. Mycorrhiza with the larch 2.
- 1*. Clamp connections, if any, very rare (subgenus *Aporpiellus* Sing.). Stipe invariably solid. Veil not becoming gelatinous, fruit bodies invariably dry (section *Solidipedes* Sing.) 3.
2. Pileus carmine-red *B. asiaticus*, p. 30.
- 2*. Pileus of another color, mostly brown *B. cavipes*, p. 28.
3. Mycorrhiza with the spruce and Douglas spruce
. *B. amabilis*, p. 30.
- 3*. Mycorrhiza with the pine or larch *B. griseopallidus*, p. 31.

1. *Boletinus cavipes* (Opat.) Kalchbr.

Boletus cavipes Opat., Comm. Hist. Nat. Fung. Bolet. Wiegmann's Arch 2(1):11, 1836. — *Boletinus cavipes* (Opat.) Kalchbr., Enum. II, p. 287, 1867.

Pileus 4–15(–17) cm in diameter, hemispherical or somewhat sub-umbonate, with advancing age completely flat, less frequently depressed, invariably with a small papilla in the center, light lemon-yellow, golden-yellow, golden-brown, to red-brown and dark brown, mat, dry, covered with a long, dense tomentum arranged in minute flocci; rarely when older — quite smooth. Flocci generally darker than the background of the pileus. Cuticle hardly detachable. Stipe of uniform thickness or somewhat swollen at the base, 3–9×8–3 cm, hollow, of the same color or somewhat lighter than the pileus, provided with an annulus. Above the annulus exhibiting a reticle consisting of decurrent tubes, below tomentose similarly as the pileus. Veil in young specimens very distinct, membranaceous, irregularly disrupting. White-gray annulus produced by this disruption rapidly disappearing leaving a whitish thickness on the stipe. Context flexible, in the pileus pale yellow, in the stipe whitish with a brown tint. Taste mild. Smell slight. Mycelium white. Tubes initially pale yellow, with advancing age greenish-yellow to olive, considerably decurrent; of average length of 1–1.3 cm, tightly connected with the pileus and therefore hardly separable. Pores pale yellow, later of more intensive color, olive-yellow, large, irregular, angular, radially elongated; minute septula deep in the pores.

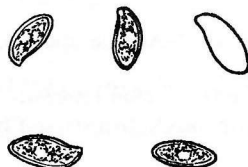


Fig. 19. Spores of *Boletinus cavipes* (Opat.) Kalchbr. (×1000).

Spore print yellow-olive. Spores ellipsoidal-fusiform with distinct drops within, $8\text{--}10 \times 3\text{--}4 \mu$ (Fig. 19). Basidia clavate, $15\text{--}36 \times 5\text{--}8 \mu$. Cystidia cylindrical or clavate, sometimes contracted at the tip; colorless to yellowish, numerous in the environ of pores, $40\text{--}50(90) \times 6\text{--}12 \mu$. Hyphae with clamp connections.

Habitat. It occurs near larches. Not common, but on its habitats it generally appears in groups. More frequently found in submontaneous regions and in mountains. In the Tatra Mts. its range reaches the altitude of 1300 m a.s.l. (Pilát). August–October.

Distribution in Poland. Known from a number of habitats: Świętokrzyskie Mts., Tatra Mts., Karkonosze Mts., Silesia, environs of Częstochowa, Puławy, Szczecin and Gdańsk.

General distribution. It occurs around the North Pole within the range of occurrence of the larch.

Notes. Edible and tasty, but rather rare. The presence of the veil, large pores and hollow stipe are the main characteristics of this fungus. Singer (1965) quotes

several forms of this species emphasizing, however, that they are of no greater importance from the systematic standpoint. According to this author *f. aureus* (Roll.) Sing. Rev. Mycol. 3:167, 1938, with a goldish to lemon-yellow pileus, stipe of a similar color in the upper part and context, when touched, becoming sordid violet, is the most important form. It has been described from the Alps. It is possible that it will be found in Poland.—Plate 3, 2-4.—Kallenbach, 27.

—*Boletinus asiaticus* Singer

Boletinus asiaticus Singer, Rev. Mycol., 3:164, 1938.

Pileus hemispherical, 4–12.5 cm in diameter, vinous-red or with age lilaceous-blood-red, dry, in the center floccose. Stipe hollow, above the annulus yellow, below vinous-red, yellowish-blood-red, fibrillose or squamate, 4–8.8×1.6 cm, at the base thicker and smooth. Veil red, dry. Mycelium white. Context yellow, exhibiting no reaction to NH_3 . Taste mild. Smell absent. Tubes irregular, decurrent, initially yellow, later olive-yellow. Pores of similar not changing color, elongated, angular.

Spore print buff-brown. Spores fusiform, with one or two drops, 11–12×4.5–5 μ . Basidia 37×6.5–7 μ . Cystidia fusiform, colorless, 60–92×10–15 μ .

Habitat. Larch forests, on the ground; fall. In Asiatic mountains up to 2200 m a.s.l. (Singer, 1938).

Distribution. In Europe, this East-Asiatic species, hitherto, has been found only in Finland (in 1954).

Notes. Very rare fungus, with a characteristic blood-colored pileus. We can expect to find it also in Poland in larch forests.—Singer 1938, IV.

—*Boletinus amabilis* (Peck) Snell

Boletinus amabilis Peck, Bull. Torr. Bot. Cl. 27:612, 1900. —*Boletinus amabilis* (Peck) Snell in Slipp et Snell, Lloydia 7:17, 1944.

Boletinus tridentinus Bres. ssp. *landkammeri* Pil. et Svr., Sborn. Nar. Mus., 513:3, 1949.

Pileus 3–12 cm in diameter, convex, later spread, ferrugineous-brown (during drought more gray-brown), when older covered with flocci among which a lighter, brown-yellow color shows. Stipe solid, 2.5–9×1–3 cm, of even thickness, at the base generally somewhat swollen, above the annulus of the same color as the pileus, below covered with fibrils and remnants of the veil. Veil white or whitish, after disruption forming a whitish (frequently with a brownish tint in some places) annulus. Context yellow, becoming slightly brown by exposure. Taste mild. Smell slight. Tubes relatively short, adnate to decurrent, light ochre to somewhat olive. Pores concolor, of variable shape, radially elongated. Anastomoses occurring near the stipe.

Spore print coffee-brown. Spores $8-12 \times 3.5-4.8 \mu$, fusiform, less frequently elongated ellipsoidal, with a distinct depression near the hilum, smooth, translucent-yellowish to olive-brown or brown. Basidia $23-33 \times 6.5-7 \mu$. Cystidia $50-60 \times 5-7.5 \mu$, cylindric to fusiform, hyaline, occasionally at the tip brownish-incrusted, numerous, occurring in fascicles at the margin of pores.

Habitat. Douglas spruce cultures and forests. October.

Distribution in Poland. Hitherto, not found.

General distribution. North America, Europe.

Notes. Chinková and Pouzar (1955) proved in details that in the case of *Boletinus tridentinus* Bres. ssp. *landkammeri* Pil. et Svr. we deal with *B. lakei* (Murr.) Sing. Considerably later, however, Singer (1965) stated that this fungus is so closely related with *Boletinus lakei* (Murr.) Sing., *Farlowia* 2:257, 1945, and differs so little from the latter that it cannot be distinguished as a separate species. In view of this, the variety distinguished by Pilát and Svrček is treated by this author as a synonym of *Boletinus amabilis* (Peck) Snell. Watling (1970) accepts Singer's view — *Suillus amabilis* (Peck) Sing. 1966 — stating at the same time that Pilát and Svrček variation "probably needs a new name." In Europe (Czechoslovakia) the presence of this North American species has been established almost recently. Probably it has been brought together with seeds of Douglas spruce. It is possible that it will be found in Poland. It differs from *Suillus tridentinus* (Bres.) Sing. by the pileus dry, when older floccose, squamate, never smooth. — Pilát et Svrček, Table 3, Photo and Plate 4 (colored), (sub *B. tridentinus* ssp. *landkammeri* Pil. et Svr.).

— *Boletinus griseopallidus* Vassilk.

Boletinus griseopallidus Vassilk., Bot. mat. sporovykh rast. 10:209–213, 1955.

Pileus 4–6 cm, convex, later flattened, pale, sordid, gray, in some places brownish, sericeous-shiny, with remnants of a membranaceous-fibrous veil at the margin. Stipe $4-6 \times 1$ cm, cylindric, fibrillose-squamate, solid, light brownish, with rapidly disappearing remnants of the veil. Context yellow, becoming bluish by exposure, when old becoming reddish. Tubes somewhat decurrent with angular, radially arranged, gray-brownish pores, $1-15 \mu$ in diameter.

Spores $9-12 \times 5-7 \mu$, ellipsoidal, grayish-brownish. Basidia clavate, $30 \times 7.5 \mu$, hyaline. Cystidia up to $70 \times 5.5 \mu$, cylindric, sometimes incrusted, generally brown, single or in fascicles.

Habitat. Mixed, coniferous, pine-larch forests.

General distribution. Found in August in Siberia in the region of the Baikal Lake.

Notes. A fungus with features intermediate between the sections of the genus *Boletinus*; it resembles also *Suillus aeruginascens* (Secr.) Snell.

Vassilkov (1967) reported also the presence of the North American species *Boletus paluster* (Pk.) Pk. in the Soviet forest — tundra.

Genus *Suillus* Micheli ex S. F. Gray

Suillus Micheli ex S.F. Gray, Nat. Arr. Brit. Pl., 1:646, 1821, emend. Snell. Mycologia 34:406, 1943. — *Ixocomus* Quél. Flore Mycol., p. 411, 1888.

Pileus fleshy, small or moderate, up to 13 cm in diameter, exceptionally up to 17 cm, with a readily detachable cuticle, smooth and viscous (during drought it can become dry and shiny) or floccose but with age becoming mucilaginous. Stipe central, fleshy, of even thickness, in the upper part smooth, reticulate or covered with glandular dots. Veil, if any, forming a more or less distinct annulus. Context generally soft, unchangeable, less frequently becoming slightly blue or pink. Tubes adnate or decurrent; pores circular and minute or elongated, large and angular, occasionally covered with drops secreted by cystidia.

Spore print ochre or brown-olive.

Edible fungi occurring on the ground, rarely on rotten wood. Almost all of them form mycorrhiza with coniferous trees. They occur in the temperate and boreal zones of the North Hemisphere, accompanying certain species of the genus *Pinus*; they are known also in some regions of tropical countries. Hitherto 28 species are known 12 of which occur in Poland.

KEY TO THE SPECIES

1. Stipe covered with glandiform grains or reticulate. Veil present or none 2.
- 1*. Stipe smooth, with no glandiform grains nor reticle. Veil invariably none 12.
2. Veil invariably present. Stipe above annulus reticulate. Habitats invariably near larches (section *Larigni* (Sing.) Sing.) . . . 3.
- 2*. Veil present or none. Stipe covered with glandular dots. Habitats near coniferous trees but not exclusively larches (section *Suillus*) 6.
3. Pores generally yellow, minute, in ripe specimens of diameter smaller than 1 mm. Pileus golden-yellow to golden-brown and red-brown. Mycorrhiza with the larch *S. grevillei*, p. 34.
- 3*. Pores generally grayish, orange-buff, less frequently yellow (when young). Diameter of pores exceeding 1 mm 4.
4. Pores orange-yellow to ferrugineous-brown (with age). Context in the pileus lemon-yellow *S. tridentinus*, p. 36.

- 4*. Pores generally white-gray or light yellow 5.
5. Pileus gray-beige to brown, occasionally with a greenish tint
. *S. aeruginascens*, p. 37.
- 5*. Pileus yellow *S. nüeschii*, p. 38.
6. Veil none (eventually it leaves no traces in the form of annulus on the stipe) 7.
- 6*. Veil invariably well visible in young specimens. In older ones it forms a distinct annulus or hangs in shreds from the margin of the pileus 10.
7. Spore print sandy-ochre. Diameter of spores generally below 1 mm 8.
- 7*. Spore print dark buff or buff-yellow with an olive tint. Diameter of spores generally exceeding 1 mm 9.
8. Context yellow-greenish. Common species occurring in masses in pine (*Pinus sylvestris*) forest
. *S. granulatus*, p. 42.
- 8*. Very rare species occurring near the stone pine (*Pinus cembra*).
Young species, in which the veil disappeared
. (see item 11: *S. sibiricus*).
9. Pileus dark brown, ochre-brown, cream-yellow or white. Context gradually becoming pink in ammonia. Habitats connected with the presence of *Pinus cembra* *S. plorans*, p. 44.
- 9*. Pileus cream-yellow, cream-lemon. Context becoming immediately red in ammonia. Habitats connected with the occurrence of *Pinus strobus* *S. placidus*, p. 43.
10. Pores minute, circular, with age angular, mostly exceeding 1 mm in diameter. Very common species, occurring mainly in pine forests *S. luteus*, p. 40.
- 10*. Pores sometimes very elongated, over 1 mm long. Tubes adnate or decurrent. Uncommon or rare species 11.
11. Tubes adnate (or slightly decurrent). Veil not glutinous, forming an irregular, rapidly disappearing annulus. Spore print buff. Habitats near the stone pine
. *S. sibiricus*, ssp. *helveticus*, p. 39.
- 11*. Tubes distinctly decurrent. Veil glutinous, with age ferruginous, forming a distinct annulus. Spore print cinnamon-colored. Habitats on very humid sites *S. flavidus*, p. 39.
12. Ripe specimens up to 8 cm in diameter. Pores brown-coppery to beige-carmine. Mycelium yellow. Taste of context peppery, rarely mild (section *Piperati* (Sing.) Sing.) 13.
- 12*. Ripe specimens exceeding 8 cm in diameter. Pores sulfur, yellow-olive, never reddish. Mycelium gray-white, some-

- times with a reddish tint or yellow. Taste invariably mild (section *Fungosi* (Smotlacha) Sing.) 15.
13. Pileus reddish-brown, its context generally flushed pink. Taste mild. Spores 5.8–8 μ *S. rubinus*, p. 46.
- 13*. Pileus ferrugineous-brown with a coppery shade, its context flesh-colored-yellow. Taste stinging either immediately or after a while. Spores larger, up to 8–12 μ long 14.
14. Ripe specimens with pilei up to 8 cm in diameter. Taste peppery. Cystidia, particularly near pores, incrustated with a kind of ferrugineous mantle *S. piperatus*, p. 45.
- 14*. Ripe specimens with pilei up to 3 cm in diameter. Taste mild, after a while — bitterish. Cystidia nonincrusted.
. *S. piperatus*, var. *amarellus*, p. 46.
15. Pores gray-yellow, with age becoming green-olive and olive-brown. Mycelium whitish, not vivid yellow. Very common species 16.
- 15*. Pores and mycelium golden-yellow. Very rare species . . .
. (see: *Phlebopus*).
16. Pores large, over 1 mm in diameter, irregular. Pileus smooth
. *S. bovinus*, p. 47.
- 16*. Pores small or moderate, about 1 mm, circular. Pileus floccose
. *S. variegatus*, p. 48.

1. *Suillus grevillei* (Klotzsch) Sing.

Boletus grevillei Klotzsch, Linnaea, 7:198, 1832. — *Suillus grevillei* (Klotzsch) Sing., Farlowia, 2:259, 1945.

Boletus flavus (With.) Fr., 1835. — *Boletus elegans* Fr. (non Schum.) 1836–1838 in Kallenb. Pilze Mitteleur., p. 37, 1926–1938. — *Boletopsis flava* (With. em. Fr.) P. Henn. in Engl. et Prantl, I, 1**:195, 1900. — *Ixocomus elegans* (Schum.? ex Fr.) Sing., Rev. Mycol., 3:39, 1938.

Pileus 4–14 cm in diameter, convex, fleshy, gradually flat-convex, mostly with a somewhat conical tip, yellow (occasionally with a lemon tint), brown-golden with various tints to red-brown, not changing color when touched, smooth, glutinous, sometimes spotted, staining hands to a rust color, occasionally rugose. Cuticle readily detachable from the context, only during drought detaches in patches. Stipe 6–8(–15) × 1–2 cm, of even thickness, yellow, frequently in the upper part brown-reddish, above the annulus covered with brown grains (sometimes larger or smaller reticulate patches occur on the shaded side), at the base yellow. Nondisrupted veil yellow near the stipe and margin, in the central zone brown or vivid yellow. After disruption it forms frequently a pituitous, ferrugineous thickness. Mycelium whitish. Context vivid yellow, when

exposed becoming sordid lilaceous to pinkish, at the base of the stipe occasionally somewhat greenish. Taste mild. Smell pleasant. Tubes 0.6–1.1 cm long, adnate or even somewhat decurrent, yellow, yellow-brownish, when old olive. Pores of similar color, occasionally pale-lilaceous directly beneath the veil, with age olive-brown, small, not exceeding 1 mm in diameter (in the central part of the pileus), angular-rounded; when damaged becoming lilaceous to brown. In some specimens covered with amber-colored liquid drops.

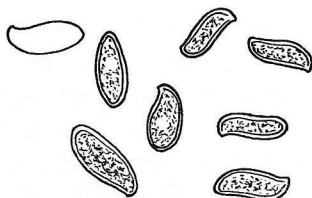


Fig. 20. Spores of *Suillus grevillei* (Klotzsch) Sing. (×1000).

Spore print ochre. Spores $(7-9(-14) \times (3-4(-5)) \mu$, ellipsoidal-fusiform (Fig. 20). Basidia $16 \times 6-7 \mu$. Cystidia generally (not always) buff, frequently incrustated, clavate, $40-70 \times 7-10 \mu$, near pores numerous.

Habitat. It occurs singly in groups or in masses in all larch forests, particularly in the mountains, in forest nurseries, also in mixed forests and parks, but invariably in the neighborhood of larches, from lowlands to the subalpine zone. In the Carpathians it reaches the altitude of 1500 m a.s.l. (Pilát). It forms mycorrhiza with the larch. June–October.

Distribution in Poland. Rather frequent, on some sites developing in masses; hitherto found in the Tatras, Pieniny and Świętokrzyskie Mts., in the Pisz Forest, in Poznań, Lublin and Warsaw voivodships, in Silesia as well as in the environs of Gdynia and Szczecin.

General distribution. Europe, northern Africa, North America.

Notes. Edible, tasty. The fungus frequently occurs in late summer in the neighborhood of larches. It can be distinguished by the vivid golden-yellow or golden-brown color of its pileus.

Very frequently in the mycological literature we find descriptions of two species of the genus *Suillus*: one with a yellow pileus and large pores called *Ixocomus flavus* (With. ex Fr.) Quél., and the second with small pores and more rugose pileus called *I. elegans* (Schum. ex Fr.) Sing. This is the way in which R. Singer (Rev. Myc. III, 1938; The Agaricales 1949) distinguishes them. According to this author F. Kallenbach described *I. elegans*.

Pilát (Klič, 1951) supports Singer's classification, though he has doubts whether *I. flavus* is actually a separate species. Konrad and Maublanc (1952) agree with Kallenbach since, despite persistent explorations, they did not find the species quoted by Bresadola and Singer. In view of this, they represent the opinion that *I. flavus* (as described by Bresadola and Singer) is a very yellow form of *Suillus aeruginascens* (Secr.) Snell. On the other hand, later Singer (1961, 1965) accepted it as a separate species and described as *Suillus nüeschii*.

The present author also endeavored to distinguish both these species, but the review of hundreds specimens allowed to establish that the material hitherto collected in Poland represents *S. grevillei* (Klotzsch) Sing. perfectly presented by Kallenbach. It seems that the habitats of the fungus called *Boletus elegans* Schum. published in Poland also really belong here. — Plate 4. — Kallenbach, 17.

2. *Suillus tridentinus* (Bres.) Sing.

Boletus tridentinus Bres., Fungi Trid., 1:13, 1881. — *Suillus tridentinus* (Bres.) Sing., Farlowia, 2:260, 1945.

Pileus hemispherical, occasionally somewhat campanulate in the center, with age flattened, 5–16 cm in diameter, covered with adhering ferrugineous-buff and buff-brown flocci among which a lighter, yellow, orange or brownish color shows; at the tip darker, toward the margins lighter. Cuticle floccose-glutinous, when old sometimes smooth, more or less shiny. Stipe 4–11×1–3.5 cm, generally of even thickness or somewhat swollen at the base, yellow and yellow-orange above the annulus, covered with a far-decurrent, brownish reticle. Below the annulus somewhat lighter, occasionally covered with ferrugineous grains. Veil membranaceous, white or cream-colored, disappearing. Mycelium whitish and pale pink or pale ferrugineous. Context relatively thick, soft, of unchangeable color, yellow-lemon in the pileus and in the upper part of the stipe; beneath the cuticle and in the lower part of the stipe yellow-ferrugineous to red. Taste mild, smell slight. Tubes adnate or far-decurrent, initially yellowish, later acquiring a vivid orange-yellow to rust and finally ferrugineous-brown color, up to 1.2 mm long. Pores angular, complex, invariably of vivid color, orange-yellow, orange-red to golden-brown and ferrugineous-brown; when ripe they are large and of pale color.

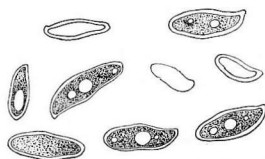


Fig. 21. Spores of *Suillus tridentinus* (Bres.) Sing. (×1000). After Wojewoda 1964.

Spore print olive, when dried — olive-yellowish. Spores ellipsoidal-fusiform, 9–13×4–6 μ (Fig. 21). Basidia 22–35×6–10 μ . Cystidia clavate to pointed, more numerous near pores, colorless to golden-brown, 27–76×6–13 μ .

Habitat. Mixed forest. Particularly under larches, forming mycorrhiza with the latter. In the Alps up to 1600 m a.s.l. (Martin, after Kallenbach). Very rare. July–September.

Distribution in Poland. Found in the Western Tatra Mts. in a coniferous forest with groups of larches, about 1080 m a.s.l. (Wojewoda, 1964) and in the Pieniny Mts. in a beech forest with a larch admixture (Gumińska, 1969).

General distribution. A prevailing part of Europe, the Alps included; the Altai Mts. and a prevailing part of Siberia.

Notes. Edible. A fungus characterized by an orange-ferrugineous, floccose pileus and large, orange pores as well as by the presence of an annulus.

Boletinus tridentinus ssp. *landkammeri* described by Pilát and Svrček as a subspecies is the synonym of the American species *B. lakei* (Murr.) Sing. (Chinková and Pouzar, 1955) brought to Europe. — Kallenbach, 29.

3. *Suillus aeruginascens* (Secr.) Snell

Boletus aeruginascens Secr., Mycogr. Suisse, 3:6, 1833. — *Suillus aeruginascens* (Secr.) Snell in Slipp et Snell, Lloydia, 7:25, 1944.

Boletus viscidus L. ex Fr. et Hök (non sensu L.), Boleti p. 12, 1835. — *Ixocomus viscidus* (L. ex Fr. et Hök) Quéél., Flore Mycol. p. 416, 1888.

Pileus up to 13 cm in diameter, convex, later flattened, whitish-gray, yellowish, gray-olive, less frequently yellow-brown to reddish-brown, in touched places frequently flushed brown. Cuticle clammy, somewhat mucilaginous and shiny, during drought floccose-fibrous; separable from the context. Stipe 3–6(–11) × 1–2(–3.5) cm, solid, thinner in the upper part, of a similar color as the pileus, gray-yellow, becoming slightly brown with age; frequently reticulate above the annulus. Mycelium white. Veil membranaceous, thin, white, irregularly disrupting; its remnants hang in lobes from the margin of the pileus or form a rapidly disappearing, lacerate annulus. Context in the pileus soft, whitish, in the stem slightly fibrous, at the base somewhat yellowish, with age — buff; when exposed the context of the stem becomes slightly greenish. Taste mild, smell

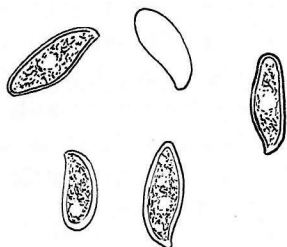


Fig. 22. Spores of *Suillus aeruginascens* (Secr.) Snell (×1000).

slight. Tubes up to 1.3 cm long, white-gray, with age sordid brownish, adnate or decurrent. Pores white-gray, later gray to gray-brown, darkening when touched, wide, angular, labyrinthine, over 1 mm in diameter.

Spore print buff-brown. Spores ellipsoidal to subfusiform $8-11(-14) \times 4-5 \mu$ (Fig. 22). Basidia $20-38 \times 5-9 \mu$. Cystidia colorless or more or less golden-brown, clavate, occasionally pointed at the tip, $40-80 \times 5-11 \mu$.

Habitat. It occurs in groups under larches. In the Carpathians found up to 1400 m a.s.l. (Pilát). Rare. May–October.

Distribution in Poland. Found only in the southern part of Poland as well as in Kamienny Potok and in the environs of Warsaw.

General distribution. Species occurring around the North Pole but also recorded in South America.

Notes. Edible. A fungus of varying shape and color, exhibiting the following characteristic features: sordid color of the pileus and large labyrinthine pores. Some authors distinguish the variety var. *bresadolae* (Quél. in Bres.) Moser in Gams, Kl. Krypt. 2:24, 1953 characterized by more vivid (red-brown with a gray tint) color of the pileus 4–10 cm in diameter, a ferrugineous-brown color of the stipe and light yellow color of the veil and annulus. This variety has been observed only in the Alps where it reaches the altitude of 1900 m a.s.l. (Singer 1965, 1, Taf. III, 14–16). — Plate 3, 6–8. — Kallenbach, 18.

4. *Suillus nüeschii* Sing.

Suillus nüeschii Sing., Sydowia 15:82, 1961.

Pileus convex, with age flattened, 4–14 cm in diameter, lemon-yellow, smooth, intensively glutinous. Stipe solid, of even thickness, light yellow, above the annulus generally yellow, below occasionally brownish, spotted; in the upper part distinctly reticulate; $5-9(-14) \times 1-2.8(-4)$ cm. Veil white-yellowish, after disruption forming a distinct, frequently glutinous on the outer part, annulus. Mycelium white, rarely yellowish-white. Context light, lemon-colored, mostly in the stipe becoming slightly bluish or greenish; when older frequently it does not become bluish but delicately lilaceous or pinkish flushed. Hyphae without clamp connections. Taste of sourish fruits, pleasant. Smell slight, fruitlike. Tubes 0.6–1.0(–1.5) cm long, adnate or slightly decurrent, light gray, when older — light yellow, when damaged — becoming gray-lilaceous or sordid gray. Pores of the same color, irregularly elongated, over 1 mm in diameter, angular.

Spore print tobacco-brown. Spores smooth, ellipsoidal-fusiform, light yellowish, typical: $8-12 \times 2.7-3.8 \mu$. Basidia clavate, $21-25 \times 6.8-8.5 \mu$. Cystidia hyaline, cylindric, fusiform to bottle-shaped, $26-70 \times 5.5-9.2 \mu$, most numerous at the margin of pores.

Habitat. Invariably under larches, in mountain and subalpine coniferous forests, in the Alps particularly in *Piceeto-Laricetum* (Singer 1965); reaching the upper limit of forests; occurring individually or in groups. July–October.

Distribution in Poland. Recorded from the Tatra Mts. but beyond the Polish frontier.

General distribution. Mountain regions of the North Hemisphere.

Notes. Edible. It is noteworthy that both Bresadola and Singer earlier called it *Boletus flavus* (With. ex Fr.). — Singer 1965, 1, Taf. III, 11–13.

5. *Suillus flavidus* (Fr. ex Fr.) Sing.

Boletus flavidus Fr. ex Fr., Syst. Mycol., 1:387, 1821. — *Ixocomus flavidus* (Fr. ex Fr.) Quél., Flore Mycol., p. 415, 1888. — *Boletopsis flavidus* (Fr.) P. Henn. in Engl. et Prantl, Nat. Pfl., I, 1**:195, 1900. — *Suillus flavidus* (Fr. ex Fr.) Sing., Farlowia, 2:260, 1945.

Pileus up to 8 cm in diameter, fleshy, hemispherical, with age flattened, usually umbonate, yellow-lemon, sometimes with a fleshlike, vinous or greenish shade. Cuticle glutinous, covered with very delicate fibrils better visible on drier places; readily separable from the context. Stipe rather slender, of even thickness, up to 8 cm long and 0.9 cm thick, provided with an annulus; above the annulus pale, gray-yellowish, occasionally glutinous, with dispersed small grains of somewhat darker color, below the annulus almost smooth, yellowish, in some places with rust spots. Veil membranaceous, glutinous, whitish with a vinous shade, later rust-brown, even rust-tawny, remaining in the form of a distinct annulus. Mycelium white-yellowish or white. Context gray-yellowish, yellow, with age darker, under the cuticle sometimes flesh-colored. Smell slight, taste somewhat sourish. Tubes gray-yellow, yellow-brown with an olive shade, decurrent, up to 1 cm long; readily detachable from the context. Pores of similar color as the tubes, large, angular, elongated, mostly 3–4 mm long, with an uneven surface (with obtuse teeth).

Spore print cinnamon-colored. Spores ellipsoidal, $8-10(-11) \times 3-4 \mu$. Basidia clavate, $15-25 \times 4-6 \mu$. Cystidia $25-50 \times 4-9 \mu$, agglomerated in fascicles, mainly near pores.

Habitat. Very humid, boggy sites (particularly mountain peatbogs). According to Pilát—mainly under the dwarf mountain pine. In Poland found under birches, pines and spruces. June–October.

Distribution in Poland. It occurs rarely, on dispersed sites: in the Izer Mts., in Lublin and Kielce voivodships, near Żary and Poznań as well as on the Vistula Sand Bar.

General distribution. Europe.

Notes. Edible. Its habitus resembles that of *Suillus luteus* and *S. aeruginascens*, but differs from the former by large pores and decurrent tubes and from the latter by the yellow-lemon pileus and gray-yellow tubes with an olive shade.—Plate 3, 1. — Kallenbach, 50.

6. *Suillus sibiricus* (Sing.) Sing.

Ixocomus sibiricus Sing., Rev. Mycol., 3:46, 1938 (sensu Favre, Et. Myc. Parc. Nat. Suisse, 1:467, 1954). — *Suillus sibiricus* (Sing.) Sing., Farlowia, 2:260, 1945.

Pileus initially hemispherical or campanulate, with age becoming flat, frequently with an obtuse umbo in the center, up to 12 cm in diameter, light straw-yellow, ochre, yellow-brown, with large brown-red or rust-brown spots. Cuticle glutinous, readily separable from the context.

Stipe of almost even thickness, 8×2.6 cm, yellowish at apex, whitish at the lower part; at the base sometimes foxy-red, throughout its length covered with tubercular, whitish granules. Granules exude droplets of an opalescent liquid and when it dries the granules acquire a vinous-brown or rust-brown color. Veil membranaceous-floccose, thick, whitish, dry; disrupting irregularly, occasionally forming a disappearing annulus on the stipe. Mostly it hangs in lobes from the margin of the pileus. After disappearing from the pileus the veil remains on its margin in the form of an irregular, rust-brown or even brown-blackish fringe. Mycelium pink. Context light straw-yellow, not becoming blue, but acquiring a rust-brown tint when exposed. Under the influence of ammonia it acquires an intensive pink color within the pileus, whereas in the stipe this reaction is slight or none. Taste somewhat sourish; smell slight. Tubes up to 11 cm long, yellowish, later light brown-olive, adnate or somewhat decurrent. Pores elongated, relatively large, up to 3 mm long, of similar color as the tubes and also covered with tubercles exuding droplets of an opalescent liquid.

Spore print buff-brown. Spores ellipsoidal, almost cylindric, most frequently containing a single droplet, $9-12 \times 3.8-4.5$ μ . Basidia narrow-clavate, $28-34 \times 7-8$ μ . Cystidia up to 75×9 μ , mainly fascicles at the margin of pores.

Habitat. Coniferous and mixed forest, invariably near *Pinus cembra*. In the Alps up to 1750–2225 m a.s.l. (Favre). July–October.

Distribution. Habitats of this fungus have been noted in the Alps and in Siberia. In Poland Frejlik (1973) found the Swiss subspecies near rock pines in the Tatra Mts. (1160 m a.s.l.).

Notes. Within the scope of the taxon described the following two subspecies are distinguished: the Siberian, ssp. *sibiricus*, derived from the Altai Mts. and the Swiss, ssp. *helveticus* Sing., Lilloa 22:657, 1949 (1951) which may be found also in the Tatra Mts. The difference between them consists mainly in the mycorrhizal partner: in the case of the Siberian subspecies it is *Pinus sibirica*, whereas for the Swiss one—*Pinus cembra*. The Swiss subspecies resembles the light forms of *Suillus plorans* (Roll.) O. Kuntze and *S. placidus* (Bon.) Sing. from which it differs by the presence of a veil, more vivid color of the pileus and the presence of spots. Of species provided with a veil it resembles most *S. flavidus* (Fr. ex Fr.) Sing, but differs from the latter by the dry veil and the stipe granular below the annulus.—Favre, I; Singer, 1965, 1, Taf. V, 1.

7. *Suillus luteus* (L. ex Fr.) S.F. Gray

Boletus luteus L. ex Fr. Syst. Mycol., 1:386, 1821.—*Ixocomus luteus* Quél., Flore Mycol., p. 414, 1888.—*Suillus luteus* (L. ex Fr.) S.F. Gray, Nat. Arr. Brit. Pl., 1:646, 1821.

[*Boletus annulatus* Pers., Syn., p. 503, 1801].

Pileus 4–13 cm in diameter, fleshy, hemispherical, with age flattened, light brown, sometimes ochre, maroon, dark brown, less frequently with a gray or olive tint, when old — generally lighter. Cuticle distinctly viscid, during drought — shiny, and radially fine-veined; very readily separable. Stipe 5–11 × 1–2.5 cm, of even thickness, solid, light yellow, goldish, at the tip light lemon and covered with minute, yellowish granules becoming quite brown with age. Veil membranaceous, white, light cream-colored, with a violet tint, with age acquiring a buff color; after disruption it hangs in lobes from the margin of the pileus or forms an annulus on the stipe. Mycelium white. Context whitish, later cream-colored, yellow, above the tubes almost lemon, in the stipe slightly buff, of invariable color, soft, somewhat aqueous. Taste mild, smell slight. Tubes lemon to golden-yellow, when old — with an olive tint, adnate, sometimes slightly decurrent, up to 1.5 cm long, readily separable from the context. Pores small, circular, with age angular, with an uneven margin, of the same color as the tubes.

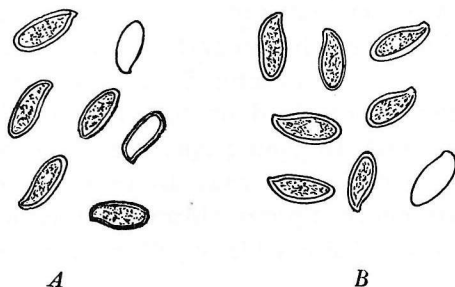


Fig. 23. A — spores of *Suillus luteus* (L. ex Fr.) S. F. Gray (×1000); B — spores of *Suillus granulatus* (L. ex Fr.) O. Kuntze.

Spore print when fresh — ochreous-sienna, when dry — ochre-yellowish. Spores ellipsoidal, $7-10 \times 3-3.5(-4) \mu$ (Fig. 23, A). Basidia $14-19(-23) \times 4-6 \mu$. Cystidia clavate, frequently with elongated tips, colorless to dark brown, single or in bundles near pores $24-60 \times 6-14 \mu$.

Habitat. Generally it occurs abundantly on sandy soils, in forest cultures, on sites overgrown with mosses or low herbs, on roadsides, invariably under pines. Occasionally it occurs under firs and larches. It appears singly at the end of summer and in masses in early fall. May–October.

Distribution in Poland. It occurs commonly all over the country.

General distribution. This circumpolar fungus is also recorded on the South Hemisphere.

Notes. Edible and very tasty. It may be readily identified by the characteristic viscid pileus and the light veil, sometimes with a violet shade. In the case when the veil disappears early it is hardly distinguishable from *Suillus granulatus* (L. ex Fr.) Kuntze — Plate 5, 5–9 — Kallenbach, 19.

8. *Suillus granulatus* (L. ex Fr.) O. Kuntze

Boletus granulatus L. ex Fr. Syst. Mycol. 1:387, 1821. — *Ixocomus granulatus* (L. ex Fr.) Quél., Flore Mycol., p. 412, 1888. — *Suillus granulatus* (L. ex Fr.) O. Kuntze, Rev. Gen. Plant., 3(2):535, 1898.

Pileus 5–13(–16) cm in diameter, fleshy, convex, later flattened, light yellow, sometimes with a pink tint, sandy-brown, rust to dark brown, sometimes fine-veined from the center to half the ray of the pileus, with age sordid-maroon. Cuticle very viscid, during drought shiny, smooth, readily separable from the context. Stipe 6–12×1–2 cm, of almost even thickness, solid, central, occasionally excentric, flesh-colored, light yellow, lemon, in old specimens slightly brown at the base. In the upper part covered with minute granules of the same color as the stipe; with age these granules become brown and the stipe acquires a granular appearance. Context tough, pale yellow, under the cuticle light yellow, toward the center — flesh-colored, in old specimens soft, yellow-greenish, at the base of the stem sometimes rust-brown. Taste mild, smell slight. Tubes adnate to the stem, in old specimens little sinuate, light yellow, with age pale greenish, olive, up to 2.5 cm long. Pores light lemon, when old rust-greenish, minute, below 1 mm in diameter, initially circular, later irregular with uneven margins. In young specimens the pores and the apex of the stipe are covered with numerous droplets of a milky fluid.

Spore print sandy-ochre. Spores ellipsoidal-fusiform, 8–10–16×3–5 μ (Fig. 23, B). Basidia up to 7.5 μ wide. Cystidia fusiform up to 65 μ long.

Habitat. It occurs mainly in late summer on light, sandy soils, on insolated, grassy clearings, on roadsides, in pine forests, generally very abundant. In the Tatra Mts. it has been observed above the range of forest, at 1800 m a.s.l. (Frejlik, 1973).

Distribution in Poland. Common all over the country.

General distribution. Europe, Asia, Africa, North America.

Notes. Edible and tasty. Old specimens may be easily mistaken for those of *Suillus luteus* (L. ex Fr.) S.F. Gray which early lost their veil. Favre (1945) analyzing fungal species of the genus *Ixocomus* (at present *Suillus*) connected with *Pinus cembra* distinguished three races within the scope of the species *I. plorans*, one of which *I. leptoporus* (see p. 44) he knew only from the literature. Singer (1947) did not support Favre's opinion and created the subspecies *leptopus* (Pers.) Sing. within the scope of the species *Suillus granulatus* (L. ex Fr.) O. Kuntze. On the other hand, Konrad and Maublanc (1952) treat it as a separate species of the Mediterranean region calling it *Ixocomus Bellini* (Inz.) Maire [= *I. leptopus* (Pers.) Gilb.]. Recently Watling (1968) supported this opinion, but transferred this fungus to the genus *Suillus*. Vassilkov (1955) described a new species from the Ural Mts. (called *Ixocomus australiuralensis*). It differs from *Suillus granulatus* (L. ex Fr.) O. Kuntze by the small number of granules on the stipe and by the light, white-pink color of the pileus. — Plate 6. — Kallenbach, 18.

9. *Suillus placidus* (Bon.) Sing.

Boletus placidus Bon., Bot. Zeitschr., 19:204, 1861. — *Ixocomus placidus* (Bon.) Gilb., Bolets, p. 132, 1931. — *Suillus placidus* (Bon.) Sing., Farlowia, 2:42, 1945.

Boletus oudemansii Hartsen, Fl. Batav. 12(186), vol. 936, 1863. — *Boletus fusipes* Heufl. in Rabenh., Fungi Eur. exsicc. 712, 1865.

Pileus 3–10–13 cm in diameter, fleshy, smooth, initially convex, later flattened, white-yellowish, later light lemon, finally yellow-brownish, viscid, when touched gradually acquiring a light violet tint. Cuticle separable from the context. Stipe of even thickness, slender, up to 16 cm long, generally longer than the diameter of the pileus, initially quite white, later at the tip yellowish, covered from apex to base with whitish glands which gradually become reddish, violet and almost black. Mycelium white. Veil none. Context whitish, above the tubes in the stipe lemon-yellowish, in the stipe of old specimens — light buff; under the influence of ammonia — rapidly becoming pink. Tubes whitish, gradually becoming lemon-yellowish to olive, relatively short, up to 1 cm long, widely adnate or slightly decurrent. Pores whitish, later lemon-yellowish, minute, irregular, covered with granules often exuding fluid droplets. Granules become brown with age.

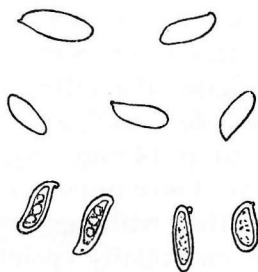


Fig. 24. Spores of *Suillus placidus* (Bon.) Sing. (After Kallenbach and Gilbert; $\times 1000$).

Spore print buff-yellow. Spores ellipsoidal-fusiform, $7-10 \times 3-4 \mu$. Basidia $16-28 \times 4-6 \mu$ (Fig. 24). Cystidia $30-66 \times 4-21 \mu$.

Habitat. It occurs both on lowlands and in mountains, invariably near *Pinus strobus* and *P. cembra*. June–October.

Distribution in Poland. Rare. Recorded from Silesia and from the Baltic coast (Żarnowiec, Elbląg, Oliwa, Polanki, Gdańsk).

Notes. Edible. Closely resembling light forms of *Suillus plorans*. It can be distinguished by the long stipe, generally longer than the diameter of the pileus, as well as by the rapid reaction of the context under the influence of ammonia and by the color of the spore print. Habitats generally connected with the presence of *Pinus strobus*. Once noted by F. Teodorowicz among spruces. According to Favre, the data on its occurrence under the stone pine should be verified.

Sometimes this fungus was wrongly called *Boletus Boudieri* Quél. Bull. Soc. Bot. Fr. 25:289, 1879; it has been recognized by Watling (1968) as a separate species and transferred to the genus *Suillus*.

Recently mycologists recognized this fungus as a separate species assuming that it differs sufficiently from *Suillus plorans* (Rolland) O. Kuntze.—Plate 3, 5.—Kallenbach, 37, Konrad and Maublanc, 415.

10. *Suillus plorans* (Roll.) O. Kuntze

Boletus plorans Roll., Bull. Soc. Myc. Fr., 5:169, 1889. — *Ixocomus plorans* (Roll.) Favre, Et. Myc. Parc. Nat. Suisse, 1:469, 1945. — *Suillus plorans* (Roll.) O. Kuntze Rev. Gen. Pl. 3(2):536, 1898.

Pileus initially hemispherical, with age flattened, sometimes with an umbo, up to 15 cm in diameter, dark brown, ochre-brown in various tints, delicately radially veined, but also sometimes sulfur-brown, straw-yellow, cream colored or white. Cuticle viscid, readily separable from the context. Margin of the pileus delicately pilose in young specimens with age becoming naked and viscid. Stipe relatively large, up to 10 cm long, of even thickness, sometimes fusiform or swollen at the base, in dark specimens brown-peach colored or ochre with an orange tint, in light specimens—light lemon or white. All over its length covered with granules of various shape, initially whitish and exuding liquid, later brown-reddish, finally dark brown. Base of the stipe floccose and pinkish. Veil none. Context buff-peach colored, in light fruit bodies white, pale lemon only near the tubes, not becoming blue. Under the influence of ammonia the pileus slowly becomes pink. Taste mild, smell none. Tubes adnate or slightly decurrent, of various length, up to 14 mm, buff with an orange or lemon-olive tint, later brownish-olive. Pores minute, circular oval, up to 2.5 mm in diameter, ochre or light sulfur, with age brown-olive; in young specimens they exude droplets of an initially opalescent and later milk-white fluid.

Spore print with an olive shade. Spores ellipsoidal-cylindrical, generally containing a single droplet, $7.5\text{--}11 \times 3\text{--}4\ \mu$. Basidia narrow, clavate, $27\text{--}35 \times 6\text{--}7.7\ \mu$. Glands on pores and on the stipe consisting of bundles of elongated, clavate cystidia up to $80 \times 12\ \mu$.

Habitat. Under stone pines, particularly on light sites. Also in mixed coniferous forests but invariably near *Pinus cembra*. In the Alps observed up to 2250 m a.s.l. (Favre). July–September.

Distribution. In Poland not found. Observed in Europe and Asia.

Notes. Edible. Its color is very variable and owing to this it can be hardly distinguished from old specimens of *Suillus luteus* (L. ex Fr.) S.F. Gray which lost their veil or from *S. granulatus* (L. ex Fr.) O. Kuntze.

Gilbert (1931) distinguished under the generic name *Ixocomus* the following closely related species: *I. placidus* (Bon.) Gilb. with a white-lemon pileus and elongated stipe occurring under *Pinus strobus* and *P. cembra*, and *Ixocomus lept-*

pus with a short stipe developing near habitats of Mediterranean pines. On the other hand, Favre (1945) claims that these are not separate species, but only races (not only physiological) of the same species: race *placidus* (connected with *Pinus strobus*), *leptopus* (connected with the Mediterranean pines) and *plorans* (connected with *Pinus cembra*). Konrad and Maublanc (1952) accepted the existence of three separate species. Singer (1947), however, represents the opinion that two separate species: *S. placidus* and *S. plorans* should be recognized under the generic name *Suillus*. This author classified *Ixocomus leptopus* (Pers.) Gilb. as *Suillus granulatus* (L. ex Fr.) O. Kuntze ssp. *leptoporus* (Pers.) Sing. Farlowia 2:272, 1945. — Favre, II.

11. *Suillus piperatus* (Bull. ex Fr.) O. Kuntze

Boletus piperatus Bull. ex Fr., Syst. Mycol. 1:388, 1821. — *Ixocomus piperatus* (Bull. ex Fr.) Quél., Flore Mycol., p. 414, 1888. — *Suillus piperatus* (Bull. ex Fr.) O. Kuntze, Rev. Gen. Plant., 3(2):535, 1898.

Pileus 3–8 cm in diameter, convex, with age somewhat flattened, ochre, buff, yellow-brown with a copper shade, of relatively stable color, smooth, during drought dry and somewhat shiny, at rainy periods — slimy and somewhat viscid; cuticle then readily separable from the context. Stipe 4–7×0.1–1 cm, fragile, solid, of even thickness or thinner at the base, sometimes slightly curved, smooth, of a color similar to that of the pileus, only at the base — light yellow. Mycelium yellow; veil none. Context relatively soft, of invariable color, yellow-lemon in the stipe, more flesh-colored in the pileus. Taste very peppery (in a variety — mild); smell slight. Tubes short, up to 0.8 cm long, adnate, slightly decurrent, rust-brown; pores darker than tubes, brown-lateritious with a copper tint, large, angular, irregular, with an uneven margin.

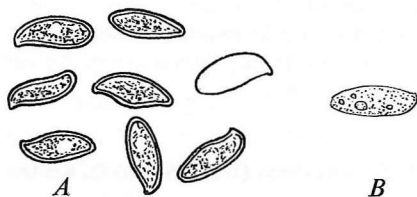


Fig. 25. Spores of *Suillus piperatus* (Bull. ex Fr.) O. Kuntze: A — var. *piperatus* (original); B — var. *amarellus* (Quél.) Sing. (After Macků, 1959) (×1000).

Spore print brown. Spores fusiform-ellipsoidal, 8–12×3–4 μ (Fig. 25, A). Basidia clavate, 18–22×7–8 μ . Cystidia occurring near the pores surrounded beneath their tips with rust deposits on outside owing to which the pores acquire a rust color.

Habitat. It occurs singly in coniferous and mixed forests, particularly in spruce cultures. July–October.

Distribution in Poland. Relatively common in the whole country. In the Tatra Mts. observed at 1700 m a.s.l. (Pilát).

General distribution. Circumpolar species.

Notes. Nonpoisonous; in view of its bitter taste sometimes used only as spice. A fungus typical for coniferous forests. It can be readily distinguished by the rust-copper pores, peppery taste and yellow mycelium. Specimens with mild taste or cystidia without deposits on outside are classified to systematic units of lower order. — Plate 7, 1–5. — Konrad et Maublanc, 419.

Var. *piperatus*

All the features of the species concern this variety. Taste peppery.

Var. *amarellus* (Quél.) Sing.

Ixocomus amarellus Quél., 11 suppl. Ass. Fr. Av. Sc., p. 398, 1882. — *Ixocomus amarellus* (Quél.) Gilb., Bolets, p. 136, 1931. — *Suillus piperatus* var. *amarellus* (Quél.) Sing., Farlowia, 2:278, 1945.

Pileus 1–3 cm in diameter, very convex, smooth, somewhat viscid, yellow ochre, at the margin reddish. Cuticle separable. Stipe about 2 cm long, solid, smooth, yellow particularly at the base, at the apex slightly covered with minute pink granules. Tubes adnate or sinuate, yellow. Pores initially yellow, soon acquiring a copper-carmine color. Context white-ochre in the pileus, with a pink shade near the tubes, yellow at the base of the stipe, of invariable color. Taste mild (at least in ripe specimens), later somewhat acrid, bitterish. Smell none.

Spore print buff-olive, sordid. Spores ellipsoidal-fusiform, granular, $10-12(-15) \times 4-5(-6) \mu$. (Fig. 25, B). Cystidia within tubes, fusiform, colorless, nonincrusted (Singer 1965: nonstable feature), $35-50 \times 6-8 \mu$.

Habitat. Singly on mountain pastures, near firs. Fall. Not common.

Distribution. In Poland this variety has not been observed.

Notes. Innocuous. The smallest fungus of the family *Boletaceae*. It differs from var. *piperatus* by the mild or only slightly bitterish taste and by cystidia without deposits. Maybe in Poland not distinguished from the former variety. In France generally treated as a separate species.

12. *Suillus rubinus* (W. G. Smith) O. Kuntze

Boletus rubinus W.G. Smith, Seem. Journ. Bot. 6:33, 1868. — *Xerocomus rubinus* (W.G. Smith) Pearson, Natur. (1946): 96, 1946. — *Suillus rubinus* (W.G. Smith) O. Kuntze, Rev. Gen. Pl. 3(2):536, 1898.

Pileus of moderate size, 5–8 cm in diameter, flat-convex, frequently flattened or protuberant, somewhat pubescent, with a slightly felty surface, frequently areolate and the lighter context is visible, buff-brown, reddish-brown and even in some places ginger-colored; cuticle after rain viscid but quickly drying. Stipe $3-6 \times 1.3-4$ cm, of even thickness or contracted toward the base, smooth, in the upper part carmine, in the lower —

yellow. Veil none. Mycelium yellow. Context in the pileus soft, cream colored with a yellow or salmon tint, in the stipe — tough to fibrous, yellow, when exposed not changing color. Taste mild, smell pleasant. Tubes 0.3–0.6 cm, adnate to somewhat decurrent, beige-carmine, later pale salmon. Pores minute, of the same color as tubes or more vividly carmine.



Fig. 26. Spores of *Suillus rubinus* (W. G. Smith) O. Kuntze ($\times 1000$) (after Macků 1959).

Spore print light-buff. Spores light brownish, smooth, wide-ellipsoidal, $5.8\text{--}8 \times 4.5\text{--}6 \mu$ (Fig. 26). Basidia and cystidia as in *Suillus piperatus*.

Habitat. Deciduous, particularly oak forests. July–September.

Distribution in Poland. It is probable that it will be found since it was recorded in Czechoslovakia (Macků 1959; Proházka 1960), in Hungary (Bohus 1958) and in the German Democratic Republic (Benedix 1957).

General distribution. Central Europe, England.

Notes. Very rare species, differing from *S. piperatus* in the first place by its carmine pileus, hymenophore and upper part of the stipe as well as by its mild taste. Recently it has been classified to the genus *Suillus* (Singer 1962). — Singer 1965, Taf. X, 1–5.

13. *Suillus bovinus* (L. ex Fr.) O. Kuntze

Boletus bovinus L. ex Fr. Syst. Mycol., 1:388, 1821. — *Ixocomus bovinus* (L. ex Fr.) Quél., Flore Mycol., p. 413, 1888. — *Suillus bovinus* (L. ex Fr.) O. Kuntze, Rev. Gen. Plant., 3(2):535, 1898.

Pileus up to 11 cm in diameter, seldom larger, very flexible, slightly convex, later flat or even depressed, often variously curved, fleshy, with a thin, initially involute margin, pale flesh-colored, buff, golden-brown, with a pink or flesh-colored tint. Cuticle smooth, viscid, shiny when dry; separable from the context only in patches, particularly near the margin. Stipe up to 10 cm long and 2 cm thick, of more or less even thickness, solid, relatively short, smooth, mat, of the same color as the pileus, sometimes paler, yellow-flesh-colored at the apex, red-brown at the base. Mycelium whitish with a flesh-colored tint. Veil none. Context viscid, very flexible (one can hardly break a piece), pale yellowish with a light brown shade in the stipe, in some places becoming slightly blue. Taste mild, smell weak. Tubes gray-yellow, with age growing greenish, adnate and decurrent, up to 1 cm long; nonseparable from the context. Pores of the same color as tubes; initially labyrinthine, later irregular, angular, with anastomoses having uneven margins.

Spore print with an olive tint. Spores ellipsoidal-fusiform, $8-10(-13) \times 3-4 \mu$ (Fig. 27, A). Basidia $25 \times 4 \mu$. Cystidia $35-45(-60) \times 5-9 \mu$, cylindrical to fusiform, colorless or yellowish, near the margin of pores generally in bundles.



Fig. 27. Spores of: A — *Suillus bovinus* (L. ex Fr.) O. Kuntze; B — *S. variegatus* (Swartz ex Fr.) O. Kuntze ($\times 1000$).

Habitat. It occurs in groups, sometimes in clusters, with pilei or stipes grown together in coniferous, mainly pine forests as well as on moorland with the presence of pines. In the Tatra Mts. it was found at 1550 m a.s.l. (Pilát). June–October.

Distribution in Poland. Edible but of secondary value. In Poland common in pine, particularly humid forests.

General distribution. It can be readily distinguished by the relatively thin and flat, buff pileus, large pores and extraordinarily flexible context from which the tubes cannot be separated. Singer (1965) distinguished the variety *viridocoerulescens* (Pearson) Sing. Sydowia 15:1861 differing from the variety *bovinus* by the greenish-blue flushed context. — Plate 5, 1–4. — Kallenbach, 28.

14. *Suillus variegatus* (Swartz ex Fr.) O. Kuntze

Boletus variegatus Swartz ex Fr., Syst. Mycol., 1:388, 1821. — *Ixocomus variegatus* (Swartz ex Fr.) Quél., Flore Mycol., p. 414, 1888. — *Suillus variegatus* (Swartz ex Fr.) O. Kuntze, Rev. Gen. Plant., 3(2):535, 1898.

Boletus macroporus Rostk. in Sturm., Deutschl. Flora 3, 5:61, Taf. 13, 1844.

Pileus up to 17 cm in diameter, convex, rather fleshy, gray-yellow, straw-yellow, mat-golden, golden-brown, gradually becoming buff, with the entire surface covered with a disheveled tomentum forming minute, darkening with age, flocci. In old specimens sometimes flocci are not visible since they either disappear or are washed away by rain. Margin in young specimen involute and floccose. Cuticle occasionally somewhat slimy, nonseparable from the pileus. Stipe $3-9 \times 3$ cm, of even thickness,

smooth, sometimes chamoislike, of a color similar to that of the pileus; buff, lemon-buff, orange-buff. Mycelium whitish. Veil none. Context cream-buff, even with an orange tint, when exposed growing bluish, in the pileus — soft, in the stipe — somewhat fibrous. Taste mild, smell slight. Tubes adnate, sometimes slightly sinuate or decurrent, up to 1.5 cm long, initially sandy, yellow, with age becoming olive, when exposed growing bluish. Pores minute or of moderate size, almost circular, initially gray-yellow, later buff-olive and rust-olive, darkening when touched.

Spore print when fresh — olive, when dry — brownish. Spores ellipsoidal-fusiform, smooth, with granular content, $8-11 \times 3-4(-5) \mu$ (Fig. 27, B). Basidia $25 \times 8 \mu$. Cystidia clavate to fusiform, colorless to golden-brown, more numerous near the margin of pores, less frequently within the tubes, $25-35 \times 8 \mu$.

Habitat. It occurs in groups in humid, marshy pine forests, less frequently on dry sites. A species characteristics for moorland with pines. Also found in mixed forests in the presence of larches as well as in the neighborhood of firs and dwarf mountain pines. In the Tatra Mts. it was observed up to 2000 m a.s.l. (Pilát). June–October.

Distribution in Poland. Common in the whole country.

General distribution. Europe and north Asia.

Notes. Edible, of moderate value. The species can be readily distinguished by its yellowish, floccose pileus, smooth stipe and context growing slightly blue. In some Polish older works it is called *Boletus aureus* Fr. — Plate 7, 6–9. — Kallenbach, 20.

Genus *Xerocomus* Quél.

Xerocomus Quél., Flore Mycol., p. 417, 1888.

Pileus more or less tomentose, chamoislike, dry, in some species, particularly after long-lasting rain, somewhat viscid. Stipe rather slender, cylindric, relatively thin, very rarely bulbous, dry, smooth, nonreticulate only in some species somewhat brown-ribbed. Veil none. Context light, invariable or acquiring a slightly blue color. Tubes adnate, frequently somewhat decurrent, with relatively wide and angular pores.

Spore print olive or buff-brown. Spores ellipsoidal-elongated, ellipsoidal-fusiform, oval and often relatively short. Cystidia average or large, smooth or slightly incrustated, not in fascicles. Hyphae without clamp connections.

Fungi occurring on the ground, at the base of trees and on fruit bodies of *Scleroderma*. Many of them form mycorrhiza with trees. All the species are edible. They are known from all continents. Hitherto above 20 species have been distinguished, five of which have been found in Poland.

KEY TO THE SPECIES

1. Pileus sometimes viscid, particularly after rain or dew 2.
- 1*. Pileus invariably dry 4.
2. Content rapidly acquires an intensive dark blue color
. see *Boletus*, p. 60.
- 2*. Context invariable or becoming only slightly blue 3.
3. Context invariable. Pileus flesh-pink. Pores golden-yellow.
Cystidia yellow see *Pulveroboletus*, p. 57.
- 3*. Context slightly growing blue. Pileus brown. Pores yellow,
when touched becoming green. Cystidia colorless
. *X. badius*, p. 51
4. Fungi developing parasitically on fruit bodies of *Scleroderma*
. *X. parasiticus*, p. 52.
- 4*. Fungi never developing parasitically on other fungi 5.
5. Context rapidly acquiring an intensive blue color
. see *Boletus*, p. 60.
- 5*. Context invariable or becoming slightly blue 6.
6. Fungi growing on ground or on rotten wood of coniferous
trees as well as at the base of spruces and pines, directly at
their roots. Pileus dark, brown, dry, during rain somewhat
glutinous. Stipe exhibiting no reaction to NH_3 . Pores small.
Context becoming slightly blue *X. badius*, p. 51
- 6*. Fungi growing on ground. Pileus of different color, never dark
brown, at the utmost avellaneous, dry, pubescent, mat. Con-
text invariable or becoming slightly blue (in species with
large pores) 7.
7. Tubes carmine, salmon see *Boletus*, p. 60.
- 7*. Tubes of different color 8.
8. Tubes greenish-yellow, soon becoming olive. (Stipe frequently
with a pink or red tint) 9.
- 8*. Tubes golden-yellow or buff-yellow 11.
9. Pileus mostly olive, areolate *X. chrysenteron*, p. 55.
- 9*. Pileus of different color 10.
10. Pileus purple, less frequently buff-red. Stipe reddish
. see *Boletus*, p. 60.
- 10*. Pileus peach-colored, with age sandy-yellow. Stipe ochre
. see *Boletus*, p. 60.
11. Pileus olive. Tubes very large, pores lemon-greenish
. *X. subtomentosus*, p. 53.
- 11*. Pileus of a different color, avellaneous to flesh-pink. Pores
whitish, buff and if lemon then never very large 12.

12. Pores of vivid yellow color; pileus invariably with a pinkish tint. Cystidia yellow see *Pulveroboletus*, p. 57.
 12*. Pore whitish with a beige tint 13.
 13. Pileus avellaneous *X. tumidus*, p. 56.
 13*. Pileus brown to reddish-brown *X. spadiceus*, p. 54.

1. *Xerocomus badius* (Fr.) Kühn. ex Gilb.

Boletus castaneus var. *badius* Fr., Syst. Mycol. 1:392, 1821. — *Boletus badius* (Fr.) Fr. Elench. Fung. 1:126, 1828. — *Xerocomus badius* (Fr.) Kühn., 1926 ex Gilbert, Bolets, p. 116, 1931.

Boletus vaccinus Fr. Epicr., p. 420, 1838.

Pileus 6–10(–16) cm in diameter, hemispherical, later more or less flat-convex, in young specimens at the margin involute, mat, delicately pubescent, sometimes smooth and slightly shiny, dry, during rainy weather even viscid (but for a short period), mostly brown, chocolate-brown, but occasionally also dark buff. Stipe 5–9×2(–4) cm, solid, of even thickness, invariably dry, mat, with delicate pubescence causing the development of longitudinal dark striae, with age smooth, ochre, buff-brown, at the apex and at the base yellowish. Mycelium whitish. Veil none. Context tough, white-cream-colored, when exposed becoming slightly bluish particularly at the tubes. Taste mild, smell slight. Tubes yellowish, with age olive, becoming greenish by exposure, adnate to the stipe and somewhat sinuate around it, less frequently somewhat decurrent, up to 1 cm long. Pores small, round and angular, yellow, when touched becoming greenish.

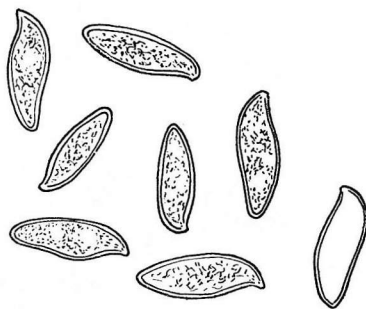


Fig. 28. Spores of *Xerocomus badius* (Fr.) Kühn. ex Gilb. (×1000).

Spore print brown-olive. Spores ellipsoidal-fusiform, 12–17×4–5 μ (Fig. 28). Basidia 35–47×11–13 μ . Cystidia 60–90×10–11 μ , colorless, fusiform or clavate; occurring within the tubes or near the pores.

Habitat. It occurs singly, mostly near the tree butts in coniferous, mainly pine, less frequently spruce and fir, forests, August–October.

Distribution in Poland. Common in the whole country in pine forests. In the Tatra Mts. it reaches the altitude of 1700 m a.s.l. (Pilát).

General distribution. Europe, Asia, North America.

Notes. Edible. The fungus can be distinguished by the very dark (generally) pileus, smooth stipe and context becoming slightly bluish.

According to French authors the name *Xerocomus tumidus* (Fr.) Gilb. refers to a quite good, rarely observed species differing from *X. badius* in the first place by the buff content which does not become blue, by the light buff pileus and the occurrence (probably exclusive) under deciduous trees.—Plate 8, 2–4.—Kallenbach, 45.

2. *Xerocomus parasiticus* (Bull. ex Fr.) Quél.

Boletus parasiticus Bull. ex Fr., Syst. Mycol., 1:389, 1821. — *Xerocomus parasiticus* (Bull. ex Fr.) Quél., Flore Mycol., p. 418, 1888.

Pileus 3–7 cm in diameter, hemispherical, later flat-convex or quite flat, sometimes excentric or even lateral, sordid yellow, olive, rust-olive, dry, tomentose, mat, with age semimat, frequently areolate. Cuticle hardly separable from the context. Stipe 3–7×0.4–2 cm, yellow to brownish-yellow, cylindric, at the base somewhat thinner, generally curved. Context yellowish, above tubes lemon-yellow, in the lower part of the stipe brownish or even brownish-reddish. When exposed becoming slightly bluish above the tubes. Taste mild and smell slight. Tubes 0.7 cm long, lemon-yellow, on the section becoming somewhat olive, widely adnate or slightly decurrent, readily separable from the pileus. Pores pale yellow, later golden-hued, finally olive, labyrinthine, angular.

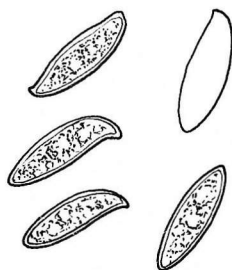


Fig. 29. Spores of *Xerocomus parasiticus* (Bull. ex Fr.) Quél. (×1000).

Spore print olive. Spores oval-fusiform, 12–18(–22)×4–5(–7) μ (Fig. 29). Basidia yellow, 30–50×8–12 μ . Cystidia clavate, pointed at the apex, colorless to golden-yellow and rust-red, 60–80×4–17 μ ; in some specimens none.

Habitat. In light mixed forests, particularly with oaks and beeches. It occurs mostly in groups as parasite on the fruit bodies of *Scleroderma*. August–October.

Distribution in Poland. Known from only few sites: Ciężkowice near Cracow, Babule in the Sandomierz Forest, Prošno near Morąg, Krynica Morska, Drezdenko and the islands Uznam and Wolin.

General distribution. Europe, north Africa, North America.

Notes. Edible. The habit of this fungus somewhat resembles that of *Xerocomus subtomentosus* (L. ex Fr.) Quél. It can be readily distinguished since it occurs invariably as parasite on fruit bodies of *Scleroderma*. — Plate 7, 10. — Kallenbach, 21.

KEY TO THE FORMS
(after Kavina, 1935)

1. Pileus yellow to olive and olive-rust, large, 3–7 cm 2.
- 1*. Pilei olive-brown, pubescent, small, 2–3 cm in diameter. Tubes and pores yellow-lemon. Stipe 5–6×0.2 cm. Spores 17–18×4 μ . Cystidia none. Known from Czechoslovakia
. f. *gracilis* Kav., Acad. Tsch. Sci., 36 : 113, 1935
2. Pileus olive to olive-rust f. *parasiticus*,
- 2*. Pileus of vivid yellow color, larger than in the typical form, during rain even viscid, during drought — shiny. Tubes and pores cinnamon-colored. Spores 14–15×4 μ . Cystidia present. Known in Czechoslovakia f. *peyllii* Kav., Mykologia, p. 96, 1925

3. *Xerocomus subtomentosus* (L. ex Fr.) Quél.

Boletus subtomentosus L. ex Fr., Syst. Mycol., 1:389, 1821. — *Xerocomus subtomentosus* (L. ex Fr.) Quél., Flore Mycol., p. 418, 1888.

Boletus eriophorus Rostk. in Sturm, Deutsch. Flora, 3(5):75, Taf. 20, 1844. — *B. cinnamoneus* Rostk. in Sturm, l.c. p. 53, Taf. 9. — *B. pannosus* Rostk. in Sturm, l.c.:79, Taf. 22. — *B. dentatus* Rostk. in Sturm, l.c. 85, Taf. 25.

Pileus 3–10 cm in diameter, hemispherical, with age flat-convex, fleshy, olive, sordid brown, sometimes with a distinct tomentum which may be fawn, toward the margins more velvety, mat and dry, sometimes during drought slightly cracking. Cuticle nonseparable from the context. Stipe cylindric, slender, at the base somewhat thinner than at the apex, 6–10(–19)×1(–2) cm, light cream-flesh-colored, yellow-ochre, somewhat fibrous, occasionally with indistinct or simply punctate granules at the apex, even with the network with elongated meshes. Veil none. Mycelium whitish. Context thick, whitish with a yellowish-greenish shade, under the cuticle brown, invariable. Taste mild, smell pleasant. Tubes up to 1.2 cm long, adnate so widely that their lower margins become slightly decurrent, when young — of vivid yellow color, with age becoming green-lemon, even with an ochre tint. When touched they do not immediately

change color; only intensively water-soaked specimens become slightly bluish. Pores relatively large, irregular, angular, a beautiful lemon-yellow color, not becoming blue.

Spore print sordid brown. Spores fusiform-ellipsoidal, $9-15 \times 4-6 \mu$ (Fig. 30). Basidia $40-45 \times 12-14 \mu$. Cystidia $35 \times 9 \mu$, clavate, colorless.

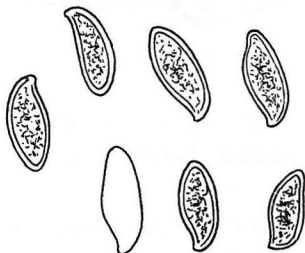


Fig. 30. Spores of *Xerocomus subtomentosus* (L. ex Fr.) Quél. ($\times 1000$).

Habitat. It occurs in deciduous and mixed forest. July–October.

Distribution in Poland. Common in the whole country. In the Tatra Mts. observed up to 1400 m a.s.l. (Pilát).

General distribution. North Hemisphere and some warmer countries.

Notes. Edible. Variable fungus but readily recognized by its green-olive pileus and golden-yellow pores. It resembles *Xerocomus chrysenteron* (Bull. ex Fr.) Quél., but the latter exhibits a more sordid green, mostly areolate pileus, yellow-olive pores and context becoming slightly blue by exposure. On the other hand, form *X. spadiceus* (Schaeff. ex Fr.), formerly sometimes treated as a form or variety of the rather variable *X. subtomentosus*, characterized by the reddish-brown pileus and brown-red granulation occurring on the more or less distinct ribs of the reticle on the stipe, *X. subtomentosus* differs by the olive or at least olive-shaped pileus. — Plate 8, 1; 9. — Maublanc, 160, Fig. 1.

Vassilkov (1955) described a new species *Xerocomus chostensis* from deciduous forests (*Quercus*, *Fagus*, *Buxus*) of the Caucasus. It differs from *X. subtomentosus* by a more vivid color of the pileus, lighter color of the stipe and context becoming pink. This author supposes that *Boletus subtomentosus* sensu Coker et Beers “the context of which frequently becomes pink” may belong to this species.

4. *Xerocomus spadiceus* (Fr.) Quél.

Boletus spadiceus Fr. Epicr. p. 415, 1838. — *Xerocomus spadiceus* (Fr.) Quél. Fl. Mycol. p. 417, 1888.

Boletus fuscus Rostk. in Sturm, Deutsch. Flora, 3(5):59, Taf. 12, 1844. — *B. latanus* Rostk. in Sturm., l.c. p. 77, Taf. 21.

Pileus 3–10 cm in diameter, convex with age flattened, brown to reddish-brown, with no olive tint, tomentose, with age smooth, nonviscid. Stipe $3.5-8.5 \times 1-2$ cm, whitish, with age yellow to brown, also with a brown granulation forming a kind of network. Veil none. Mycelium yellowish-white to yellow. Context white to yellowish, when touched —

becoming bluish (quite fresh). Taste mild, smell slight. Tubes light yellow, becoming bluish when damaged, adnate to somewhat decurrent, 0.5–1.4 cm long. Pores of similar color, generally labyrinthine, less frequently angular-circular, becoming bluish when touched.

Spore print olive. Spores cylindric to fusiform, smooth, $9.5\text{--}14 \times 4\text{--}5 \mu$, yellowish. Basidia $25\text{--}35 \times 7\text{--}10 \mu$, clavate. Cystidia $30\text{--}60 \times 6\text{--}12 \mu$, sometimes at the tip, hyaline, numerous at the margin of pores.

Habitat. Mixed forests, particularly those with *Fagus sylvatica* or *Abies alba*.

Distribution in Poland. Recorded in this country by older authors.

General distribution. Europe, North America.

Notes. Probably edible. For a long period many contemporary authors considered this species as uncertain. Recently, Singer (1965) assumed it as solid, only mistaken for *X. subtomentosus* (L. ex Fr.) Quél. from which it differs by the lack of olive tint of the pileus as well as the lack of brown, anastomosing ribs on the stipe. — Singer 1965, XI, 4, 5–11.

5. *Xerocomus chrysenteron* (Bull. ex St.-Amans) Quél.

Boletus chrysenteron Bull. ex St.-Amans, Fl. Agen. p. 555, 1821. — *Xerocomus chrysenteron* (Bull. ex St.-Amans) Quél. Enchir. p. 157, 1886.

Pileus 3–7 cm in diameter, flat-convex, later flattened, buff, ochre or sordid olive, dry, tomentose, with age (particularly at the period of fine summer weather) cracking into irregular patches and then showing flesh-colored context below with a pink, blue and amethystine tint. Stipe $3\text{--}7 \times 1$ cm, of even thickness, straight or somewhat curved, light, ochre, in some places reddish or greenish, somewhat fibrous, when touched be-

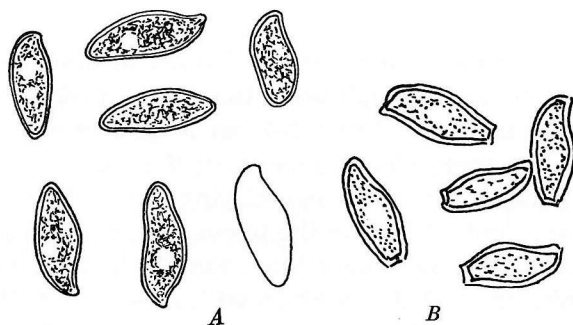


Fig. 31. Spores of *Xerocomus chrysenteron* (Bull. ex St.-Amans) Quél., A—f. *chrysenteron*, B—f. *truncatus* (Sing., Snell et Dick) Sařata ($\times 1000$)—after Sařata (1971).

coming slightly bluish. Veil none. Mycelium whitish to light yellowish. Context soft, cream-colored, under the cuticle cream-pink, when exposed becoming slightly bluish. Taste somewhat sourish, small slight. Tubes up to 1 cm long, adnate, cream-yellow, later greenish-yellow, finally olive,

becoming greenish when cut. Pores of similar color, angular, uneven, relatively large.

Spore print sordid brown to olive. Spores $12-16 \times 4-5 \mu$, oval-fusiform (Fig. 31, A). Basidia $22-27 \times 9-10 \mu$. Cystidia $60-75 \times 9-10 \mu$.

Habitat. It occurs rather frequently in coniferous, and particularly in mixed, humid and moderately shaded forests. In mountains it is observed up to 1700 m a.s.l. (Pilát). July–November.

Distribution in Poland. Relatively common in the whole country, particularly in mixed forests.

General distribution. Europe, Asia, north Africa, America, Australia.

Notes. Edible. It is most closely related to *Xerocomus subtomentosus* (L. ex Fr.) Quél. from which it differs by its size (smaller), darker, greenish, frequently areolate pileus and yellow-olive, not lemon-yellow, pores. — Plate 10, 1–5. — Maublanc 161, Fig. 1.

Recently Salata observed fruit bodies of *X. chrysenteron* collected during drought and exhibiting all the typical morphological features. On the same sites there occurred fruit bodies with spores having one end obtuse, typical for *X. truncatus* Sing., Snell et Dick (Fig. 31, B). The latter species is so similar to *P. chrysenteron* that, according to Singer (1965), probably they were mistaken for each other. Salata (Acta Mycol. 7:13, 1971) analyzed the morphology of fungi as well as the structure of spores, the habitats and the atmospherical conditions at this period and advanced the conclusion that probably the long-lasting drought is the direct cause of certain changes in the shape of spores. In view of this he assumed that *X. truncatus* Sing., Snell et Dick, Mycologia 51:573, 1959 (1960) is an ecological form of *X. chrysenteron*.

— *Xerocomus tumidus* (Fr.) Gilb.

Boletus tumidus Fr., Hym. Eur., p. 501, 1874. — *Xerocomus tumidus* (Fr.) Gilb., Bolets, p. 145, 1931.

Pileus hemispherical (when young), 3–8 cm in diameter, with a protruding and involute margin, delicately tomentose, mat, brown-rust, avel-laneous with an orange tint. Stipe 2–7 cm long, fusiform, yellow at the base, whitish at the apex, ribbed mainly in the upper part; at the apex slight network (visible through a magnifying glass). Flocci very delicate (magnifying glass). Context buff in the pileus, white in the stipe, becoming buff on the surface. Not becoming blue. Smell pleasant, taste mild with small traces of bitterness. Tubes whitish with a beige tint. Pores relatively large (2 per 1 mm), of similar color, rounded or somewhat elongated.

Spore print yellow-olive. Spores ellipsoidal, wide-fusiform, $9.5-12 \times 5-6 \mu$. Basidia clavate, $8.5-41 \mu$ long. Cystidia rare (with the exception of the environ of pores), colorless, mostly obtuse at the tip, $28-37 \times 9 \mu$.

Habitat. Probably exclusively under deciduous trees. Rare. Occurring at the end of summer and beginning of fall.

Distribution. Western European species. In Poland hitherto not observed.

Notes. This fungus resembles *Xerocomus badius* (Fr.) Kühn. ex Gilb., but it differs from the latter by the context becoming buff and never blue, ribbed stipe, lighter and delicately tomentose pileus with protruding margin, and by the occurrence on different sites.

This species is poorly known and sometimes assumed as identical with *Xerocomus badius* (Fr.) Kühn. ex Gilb. Singer (1945) claims that we dispose of too little data with regard to this species to classify it correctly. Imler (1954) claims that these are quite separate species. Recently Singer (1965) included it into the group of fungi insufficiently known or the taxonomic position of which is uncertain. — Imler (1954), pl. C; Singer (1965), Taf. X, 11–15.

Genus *Pulveroboletus* Murr. em. Singer.

Pulveroboletus Murr., Mycol., 1:9, 1909; em. Sing. Am. Midl. Nat. 37:5–7, 1947, *Boletus* subg. Heim, Rev. Mycol., 1:6, 136. — *Phlebopus* (Heim) Sing., Ann. Mycol., 34:326, 1936.

Aureoboletus Pouzar, Česka Mykol. 11:48, 1957.

Mediocre or large fungi, with a flesh-pink, golden or golden-brown pileus, generally viscid when wet, with a stipe of even thickness, sometimes swollen or contracted at the base, smooth. Veil none or hardly developed. Context yellow, becoming light blue by exposure or invariable, whitish, in the pileus, particularly above the tubes — pinkish. Tubes golden-yellow. Fungi belonging to this genus occur on all the continents. Of the 14 species known, three occur in Europe (belonging to the sections *Auripori* (Sing.) Sing. 1947 and *Sulphurei* Sing. 1947).

KEY TO THE SPECIES

1. Pileus flesh-pink; context under the cuticle pale pink . . .
P. *cramesinus*, p. 57.
- 1*. Pileus buff-rust or lemon-yellow, context yellow . . . 2.
2. Pileus lemon-yellow, silky-tomentose . . . P. *hemichrysus*, p. 58.
- 2*. Pileus buff-rust, frequently areolate . . . P. *lignicola*, p. 59.

1. *Pulveroboletus cramesinus* (Secr.) Moser

Boletus cramesinus Secr., Mycogr. Suisse, 3:39, 1833. — *Xerocomus cramesinus* (Secr.) Gilb., Bolets, p. 137, 1931. — *Pulveroboletus cramesinus* (Secr.) Moser in Gams, Kl. Krypt.-Fl. IIb:33, 1955.

Boletus sanguineus var. *gentilis* Quél., Ass. fr. Av. Sci. (1883):504, 1883. — *Ixo-*
comus sanguineus var. *gentilis* Quél., Flore Mycol., p. 413, 1888. — *Xerocomus gentilis*
(Quél.) Sing., Rev. Mycol. 5:6, 1940. — *Pulveroboletus gentilis* (Quél.) Sing., Am. Midl.
Nat., 37:17, 1940.

Pileus up to 4(-7) cm in diameter, convex, with a somewhat flattened top, with an involute margin when young, pale, pink-gray, flesh-pink, less frequently pink-brown. Cuticle smooth, viscid, clammy, during drought—smooth, shiny; separable in patches from the context. Stipe 5×1.5 cm, of even thickness or contracted at the base, solid, less frequently in some places hollow, at the apex golden-yellow like pores, but at the base quite light, smooth, occasionally somewhat viscid, generally dry. Veil hardly developed. Mycelium whitish. Context soft, of invariable color, whitish, in the upper part of the pileus and at the apex of the stipe pink flushed. Taste mild, somewhat sourish, smell slight. Tubes golden-yellow, only in old specimens with an olive-brown tint, adnate, sometimes indented at the stipe or slightly decurrent, up to 8 mm long. Pores of vivid yellow color, retaining this color after drying, minute and round when young, with age wider and somewhat angular, with uneven margin.



Fig. 32. Spores of *Pulveroboletus cramesinus* (Sacc.) Moser (×1000).

Spore print olive. Spores ellipsoidal-fusiform, 9-15(-18)×4-5(-8) μ (Fig. 32). Basidia 21-32(-47)×9 μ . Cystidia fusiform and clavate, lemon-yellow, numerous near pores, 30-50(-86)×8-20 μ .

Habitat. It occurs in deciduous and mixed forests, singly or in small groups. Rare. June-October.

Distribution in Poland. Found once in a mixed forest with admixture of oak in the basin of the Łososianka River near Kuźnica Białostocka recorded under the name of *Boletus auriporus* Peck which, contrary to Kallenbach's opinion, concerns (Singer 1965) the American species.

General distribution. Europe, northern Africa.

Notes. Edible. The species is characterized by the vivid yellow tubes, pores and stipe as well as the viscid, flesh-pink pileus.—Plate 8, 5-6.—Kallenbach, 36 (sub *Boletus auriporus* Peck).

2. *Pulveroboletus hemichrysus* (Berk. et Curt.) Sing.

Boletus hemichrysus Berk. et Curt., Ann. Mag. Nat. Hist. II. 12:429, 1853. — *Pulveroboletus hemichrysus* (Berk. et Curt.) Sing., Sydowia 15:82, 1961.

Boletus sulphureus Fr., Epicr., p. 413, 1838, non Bull. ex Mérat. — *Xerocomus sulphureus* (Fr.) Quél., Flore Mycol., p. 419, 1888. — *Phlebopus sulphureus* (Fr.) Sing. Am. Midl. Nat., 37:3, 1947.

Pileus 5–20 cm in diameter, convex, with a somewhat flattened apex, sulfur-yellow, silky-tomentose, covered at least at the margin with rust colored patches with age, somewhat viscid when wet. Stipe 4–10×1–3 cm, thickened in the lower part, central, less frequently excentric, yellow, with age gray-rust, smooth. Veil hardly developed. Mycelium woolly, golden-yellow. Context thick, light, sulfur-yellow, becoming light blue by exposure; in old specimens—invariable. Taste mild, smell slight. Tubes adnate or slightly decurrent, short, up to 7 mm long, golden-yellow, when touched acquiring rust and later greenish-blue tint. Pores small (3 per 1 mm), sulfur-yellow, with age greenish.

Spore print with an olive tint. Spores obovate to cylindrically elongated, 7–11×3–4.8 μ . Basidia 16–38×6–8 μ . Cystidia clavate or fusiform, numerous near pores, 20–36×9–12 μ .

Habitat. At the base of trees, on rotten trunks, on sawdust in coniferous, particularly pine, forests. August–October.

Distribution in Poland. Very rare species, observed but twice: in the Malinka Valley near Cieszyn and in Lubomierz near Lwówek.

General distribution. Europe, North America.

Notes. It is not known whether it is edible. The species is characterized by the sulfuric color of the entire fruit bodies as well as their occurrence on rotten trunks and sawdust. — Plate 8, 7. — Kallenbach, 25, Figs. 17, 18.

3. *Pulveroboletus lignicola* (Kallenb.) Moser

Boletus lignicola Kallenb., Pilze Mitt., 1:57, 1929. — *Xerocomus lignicola* Sing., Ann. Mycol., 40:43, 1942. — *Gyrodon lignicola* (Kallenb.) Heinem., Bull. Jard. Bot. Etat, 31:328, 1951. — *Ixocomus lignicola* (Kallenb.) Konr. et Maubl., Agaric. 2:131, 1952. — *Phlebopus lignicola* (Kallenb.) Moser in Gams, Kleine Krypt., 2b:31, 1955. — *Pulveroboletus lignicola* (Kallenb.) Pilát, Česka Mykol. 19:180, 1965.

Pileus 3–9 cm in diameter, frequently excentric, hemispherical, gradually flattened, with more or less involute margin, buff-brown to rust, more or less delicate tomentose, with age slightly scaly or felty, cracking into irregular patches and then showing rust-yellow context below. Cuticle separable in patches from the context. Stipe 3–8×0.7–2.7 cm, of even thickness, rust-yellowish to brown-rust, at the base sulfur-lemon. Veil none. Context lemon-yellow, under the cuticle—buff, becoming more or less light blue particularly at the base of tubes, soft. Taste slightly sourish, smell aromatic. Tube short, about 10 cm long, adnate to more or less decurrent, lemon-yellow, gradually greenish-yellow; separable from the context. Pores initially light, rust-yellow, later golden-yellow, when touched becoming blue, of average size, angular.

Spore print olive. Spores short-ellipsoidal to fusiform-ellipsoidal, $6-9 \times 3-4 \mu$. Basidia clavate, $16-35 \times 5-8 \mu$. Cystidia lanceolate and ventricous or fusiform, more numerous near pores, $29-80 \times 4-9 \mu$. Hyphae without clamp connections.

Habitat. It occurs at the bases of coniferous trees as well as on debris of these trees. Very rare. June–August.

General distribution. Found only in German Republics in several localities and recently also in west-central Africa and Canada.

Notes. This species is closely related to *Pulveroboletus hemichrysus*; it differs from the latter by the darker, rust, frequently areolate pileus. In 1945 Singer was not sure whether this fungus belongs to the genus *Xerocomus* or is only a form of *Phlebopus hemichrysus*. Pilát (1965) found it in Czechoslovakia and established its systematical position.

Genus *Boletus* Dill. ex Fr.

Boletus Dill. ex Fr., Syst. Mycol. 1:385, 1821.

Fruit bodies large, robust. Pileus fleshy, hemispherical with age flattened, dry, smooth or tomentose. Stipe thick, cylindrical or bulbous, covered with a distinct network or grains, less frequently smooth. Veil none. Context white to yellow, of invariable color or becoming more or less blue; taste mild or bitter. Tubes long, adnate or indented around the stipe. Pores when young closed, white, yellow, orange, blood-red, when old more or less rapidly becoming olive.

Spore print olive with a brown tint. Spores fusiform, relatively large, over 10μ long. Hyphae without clamp connections.

Fungi occurring in forests on the ground and in the vicinity of trees with which they form mycorrhiza. Here belong both edible most sought after species and species not utilized owing to their bitterness or poisonous properties. Widely observed, but more closely connected with warmer localities of the temperate zone. Hitherto 45 species are known from the entire world.

KEY TO THE SPECIES

1. Pores white (when young) or yellow, with age more or less olive; never red 2.
- 1*. Pores of ripe specimens orange, blood-red, only exceptionally lemon-colored. Stipe covered with a network or minute grains, seldom quite smooth. Context of mild taste, becoming

- more or less blue, less frequently invariable (section *Luridi* Fr.) 11.
2. Stipe reticulate; never vivid yellow nor cherry-red. Tubes and pores when young — white, with age growing yellow and becoming olive (section *Boletus*). In Europe there occurs a single species with several varieties *B. edulis*, p. 64.
- 2*. Stipe nonreticulate, lemon-yellow or with an intensive cherry-red tint. Tubes and pores already when young — yellow to lemon, with age becoming olive 3.
- 2**. Stipe and content yellow with a mild taste or white-cream-colored or pale lemon context, but then bitter; context becomes slightly blue by exposure. Pores yellow-lemon, with age — olive 5.
3. Pileus lemon to beige. Stipe thick, of similar color (classified to section *Luridi* Fr.) *B. junquilleus*, p. 82.
- 3*. Pileus brown or cherry-red (section *Subpruinosi* Fr.). Stipe of more or less even thickness 4.
4. Pileus brown. Context (and pores) lemon, becoming intensively blue *B. pulverulentus*, p. 74.
- 4*. Pileus pink to cherry-red. Context light lemon (pores deeper yellow), becoming light blue *B. rubellus*, p. 72.
5. Pileus light, grayish, occasionally brown, but then stipe without network. Tubes becoming blue when damaged. Context white-cream-colored, becoming blue. Taste in the first moment mild, later distinctly bitter or at once bitter 6.
- 5*. Pileus gray to brown and light carmine. Stipe yellow with various tints, occasionally with a pink coating, delicately but distinctly reticulate. Context more or less yellow, invariable or becoming light blue. Fungi with a mild taste, not poisonous (section *Appendiculati* Konrad et Maubl.) 8.
6. Stipe without network. Context sourish, smell of coumarin *B. fragrans*, p. 81.
- 6*. Stipe reticulate. Context at the first moment mild, later bitter (section *Calopodes* Fr.) 7.
7. Stipe brown or only in the upper part yellow and lower blood-red *B. calopus*, p. 68.
- 7*. Stipe pale pink, without traces of red *B. radicans*, p. 69.
8. Pileus yellow-pink or carmine, mostly fibrillose, stipe chrome-yellow. Context, tubes and pores yellow 9.
- 8*. Pileus not carmine. Context, tubes and pores become blue or livid by exposure 10.

9. Context or invariable color when cut *B. regius*, p. 70.
- 9*. Context becoming distinctly blue or livid
. *B. speciosus*, p. 72.
10. Pileus buff to brown. Pores light yellow or golden yellow.
Stipe yellow, yellow-ochre, generally without pink coating
. *B. appendiculatus*, p. 69.
- 10*. Pileus gray-silverish, very light ochre, gray. Pores vividly
lemon-colored. Light lemon stipe with a chamoislike pink
. *B. Fechtneri*, p. 71.
11. Stipe reticulate 12.
- 11*. Stipe nonreticulate, smooth or granulose 15.
12. Pileus generally of vivid color, yellow-orange and buff, red,
olive. Context beneath tubes light orange, becoming inten-
sively blue by exposure *B. luridus*, p. 75.
- 12*. Pileus gray with a greenish, pink or buff shade. Context be-
neath tubes generally yellow, becoming rather intensively
livid by exposure 13.
13. Pileus with a greenish shade. Context white-yellowish.
Stipe yellow at the apex and at the base, pink flushed in the
central part. Smell of old specimens unpleasant
. *B. satanas*, p. 76.
- 13*. Pileus with a pink shade 14.
14. Context deep yellow, becoming light blue. Stipe only at the
apex yellow, besides blood-red in both the meshes and ribs
of the network. Lack of specific smell
. *B. rhodoxanthus*, p. 78.
- 14*. Context light yellow, becoming intensively blue. Smell un-
pleasant *B. satanoides*, p. 79.
15. Context invariable *B. impositus*, p. 81.
- 15*. Context becoming more or less blue 16.
16. Pileus of rather vivid color, yellow or olive-brown, orange
to blood-red. Stipe smooth, at most slightly punctated. Con-
text yellow, at the base sordid carmine, becoming more or
less, but not intensively, blue and later green
. *B. queletii*, p. 80.
- 16*. Stipe distinctly, densely and granularly punctated, but with
no distinct relief. Pileus dark brown. Context yellow, be-
coming intensively blue *B. erythropus*, p. 79.
- 16**. Pileus gray, gray-beige, frequently with a pink tint. Stipe
covered with a punctation arranged in zigzags forming a kind
of network. Context frequently with an avellaneous band in
the pileus *B. lupinus*, p. 78.

ADDITIONAL KEY TO THE SPECIES

1. Pores of ripe specimens orange or blood-red. Context becoming more or less blue 2.
- 1*. Pores of ripe specimens not red 9.
2. Stipe without network 3.
- 2*. Stipe covered with network 4.
3. Context becoming intensively blue. Stipe with distinct granular punctation. Pileus brown *B. erythropus*, p. 79.
- 3*. Context becoming light blue. Stipe smooth. Pileus of more vivid color to orange *B. queletii*, p. 80.
- 3**. Context becoming light blue. Stipe with punctation arranged in zigzag lines; frequently with an avellaneous band in the pileus. Pileus red to blood-red *B. lupinus*, p. 78.
4. Context becoming weakly blue 5.
- 4*. Context becoming intensively blue 9.
5. Network yellow *B. speciosus*, p. 72.
- 5*. Network pink to red 6.
6. Entire stipe blood-red. Pileus gray with a pink tint *B. rhodoxanthus*, p. 78.
- 6*. Stipe not red 7.
7. Stipe yellow at the apex and at the base, generally pink flushed only in the central part. Pileus gray with a greenish tint *B. satanas*, p. 76.
- 7*. Entire stipe light yellow. Context in the pileus frequently with an avellaneous band *B. lupinus*, p. 78.
8. Pileus gray with a pink tint. Network on the stipe blood-red *B. satanoides*, p. 77.
- 8*. Pileus olive to sordid red, less frequently buff. Network rust *B. luridus*, p. 75.
9. Stipe covered with network 10.
- 9*. Stipe without network 15.
10. Taste bitter (sometimes not at the first moment) 11.
- 10*. Taste mild 12.
11. Stipe pale yellow, with no red traces *B. radicans*, p. 69.
- 11*. Stipe brown or only at the apex yellow, and below blood-red *B. calopus*, p. 68.
12. Context white or yellow, invariable 13.
- 12*. Context yellow, becoming light blue 17.
13. Pileus yellow-pink or carmine. Context yellow. Stipe chrome-yellow. Rare species *B. regius*, p. 70.

- 13*. Pileus whitish, buff, brown, reddish-brown. Context white.
Stipe not yellow. Common species *B. edulis*, p. 64.
14. Pileus buff to brown. Stipe generally without pink coating
. *B. appendiculatus*, p. 69.
- 14*. Pileus gray-silvery, milk-coffee colored. Stipe generally with
a light pink band *B. Fechtneri*, p. 71.
- 14**. Pileus red to blood-red. Stipe lemon, frequently red flushed
. *B. speciosus*, p. 72.
15. Taste bitter, at least in the first moment *B. fragans*, p. 81.
- 15*. Taste mild 16.
16. Context becoming blue 17.
- 16*. Context invariable *B. impolitus*, p. 81.
17. Context becoming weakly blue; pileus pink to cherry-red
. *B. rubellus*, p. 72.
- 17*. Context becoming rapidly and intensively blue 18.
18. Pileus brown *B. pulverulentus*, p. 74.
- 18*. Pileus lemon to beige *B. junquilleus*, p. 82.

1. *Boletus edulis* Bull. ex Fr.

Boletus edulis Bull. ex Fr., Syst. Mycol., 1:392, 1821.

Boletus bulbosus Schaeff. ex Schroet. in Cohn. Krypt.-Fl. Schles., 3:499, 1888.

Pileus 9–25 cm in diameter, fleshy, intensively convex when young, less frequently quite flat, dry, in wet weather slightly viscid, occasionally somewhat rugose, then more or less expanding, light brown, maroon to dark brown. Young specimens developing on very sandy soil very light, almost white-sandy, with age darkening acquiring the color of dry oak leaves. Cuticle nonseparable from the context; only during bad weather when the pileus becomes temporarily viscid, it may be peeled off in some places. Stipe 9–20×2–6 cm, cylindrical or bulbous, less frequently thin and straight, light fulvous, flesh-colored, light or dark brown, covered from the apex to the middle or 3/4 of its length with a light, distinct flesh-colored network. Context up to 3.5 cm thick, white, beneath the cuticle of the pileus sometimes flushed ochre-pink, invariable, tough. Taste mild, smell pleasant. Mycelium white. Tubes free or indented, up to 3 cm long, when young white, with age becoming yellow and greenish; readily separable. Pores minute, circular, regular, when young white and closed, old — yellow-green to olive.

Spore print brownish-green. Spores fusiform, 12–18×5–6 μ , (Fig. 33). Basidia 40–50×10–12 μ . Cystidia 36–48×4–10 μ .

Habitat. It occurs in deciduous and mixed, mainly oak-hornbeam forests with pines, spruces or firs, from spring to late fall.

Distribution in Poland. Common.

General distribution. Holarctic species, found in Europe, Asia, northern Africa, North America, Australia.

Notes. The white, invariable context of mild taste and the light network on the stipe sufficiently characterize this sought after fungus classified by consumers to fungi of high economic value. Within the scope of this species several subspecies (Singer 1965) or varieties (Skirgiełło 1960) can be distinguished.

According to Skirgiełło the variability of the species and its ecological forms are particularly noteworthy. — Plates 12–16. — Maublanc, 166.

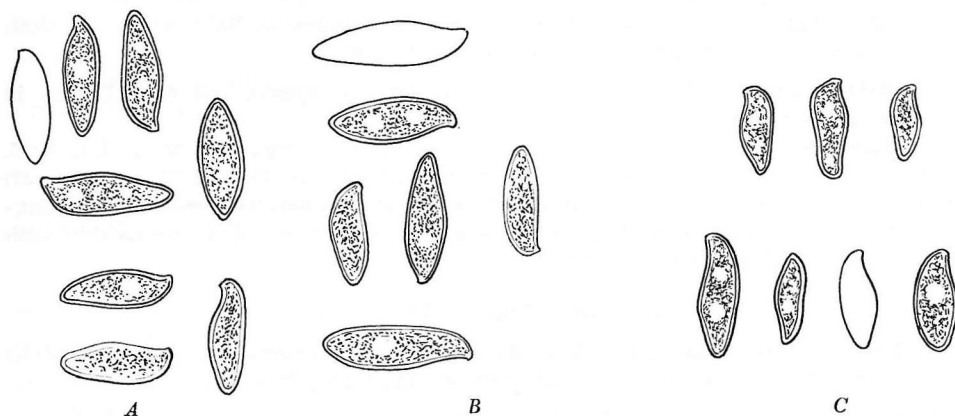


Fig. 33. Spores of *Boletus edulis* Bull. ex Fr.: A—var. *edulis*; B—var. *pinicola* (Vitt.); C—var. *reticulatus* (Schaeff, ex Boud.) Bat. (×1000).

KEY TO THE VARIETIES

1. Pileus and stipe dark brown 2.
- 1*. Pileus very light, sandy, buff to brown, but not very dark. Stipe buff to quite light 3.
2. Pileus chocolate-brown. Stipe uniformly brown. In oak forests var. *aereus*, p. 66.
- 2*. Pileus brown, with an intensive carmine tint. Network on the stipe flesh-colored. Mainly in pine forests var. *pinicola*, p. 66.
3. Pileus brown. Stipe lighter, buff, covered from the tip to 2/3 of its length with a white-flesh-colored network. Common in mixed forests var. *edulis*, p. 66.
- 3*. Pileus generally very light or buff, occasionally also brown, but then stipe very light. Network also developed. Varieties connected with various forest types 4.

4. Pileus brown. Stipe light, almost white, covered with a network only on the upper half. Spruce forests var. *piceicola*, p. 67.
- 4*. Pileus sandy to sordid white. Mostly deciduous forests 5.
5. Pileus sandy. Stipe completely covered with network. Mainly deciduous forests var. *reticulatus*, p. 67.
- 5*. Pileus light brown to sordid white. Birch forests var. *betulicola*, p. 68.

Var. *edulis*

Pileus pale chestnut-brown. Stipe cylindrical to bulbous, light, at least to half its length covered with a white-flesh-colored network.

Habitat and distribution. The typical variety is common all over Poland in various, mainly mixed, forests.

Notes. Singer distinguished the ssp. *clavipes* (Peck.) Sing., Am. Midl. Nat. 37:25, 1947 rarely occurring in Europe, perhaps brought. Snell and Dick (1970, p. 64, pl. 32) give an illustration of this fungus unknown to the present author, whereas Singer (1965) presents such a specimen which can be observed in Polish forests (but with a lighter apex of the stipe) Fig. 33, A.

Var. *aereus* (Bull. ex Fr.) comb. n.

Boletus aereus Bull ex Fr., Syst. Mycol., 1:393, 1821 (basionym). — *Boletus edulis* ssp. *aereus* (Bull. ex Fr.) Konr. et Maubl., Icon. sel., 6:454, 1935.

Pileus up to 16 cm in diameter, convex, fleshy, chocolate-brown, dark chestnut, brown with an olive to black-brown tint, chamoislike. Stipe 8×2–5 cm, completely brown-rust, covered with a dark brown network. Context white, with a yellowish tint. Tubes free, white, becoming yellow to yellow-olive. Pores white, later yellow to yellow-olive.

Habitat. It occurs mainly beneath oaks in dry and light forests in summer and fall. Rare.

Distribution in Poland. Southern part of the country, Silesia, Poznań Voivodship. To the north it has been recorded from the environs of Gdańsk and Elbląg.

General distribution. Europe, east Asia, north Africa, North America.

Notes. Singer (1965) claims that this variety is Fries' autonomic species, the present author, however, is not sufficiently convinced neither by Singer nor Pilát and Ušák (1959, Table 3, Figs. 1–4) and therefore it is presented within the scope of the species *Boletus edulis*. — Plate 16, 5. — Kallenbach, 46.

Var. *pinicola* (Vitt.) Konrad et Maubl.

Boletus edulis Bull. ex Fr. var. *pinicola* Vitt., Fungi Mang., p. 168, 1835. — *B. edulis* (Bull. ex Fr.) var. *pinicola* (Vitt.) Konrad et Maubl. Icon. Sel. 6:453, 1935 (incl. var. *fuscioruber* (Forqu. ap. Quél.). Bat. Bol. p. 14, 1908).

Boletus edulis Bull. ex Fr. var. *pinicola* Vassilk. ex Vassilk., Sedobn. yad. griby, p. 41, 1948.

Pileus fleshy, convex, up to 30 cm in diameter, dark ochre, with a dark carmine, golden-brown and rust-brown to rust-blood-red tint, dry, mat. Cuticle slightly

protruding beyond the margin of the pileus; at the margin whitish-yellowish. Stipe robust, tough, 6-8×3,6 cm, light brown, at the base yellow-brown, on the entire length covered with a flesh-colored network. Context white, under the cuticle pink-yellow to vinous, invariable, with a pleasant taste and smell. Tubes free, when young—white, when old—dark, greenish-brown, with pores initially white, later cream-colored and olive, with a slight rust tint.

Spore print olive. Spores 12-18×4-6 μ (Fig. 33, B). Basidia 20-37×11-13 μ . Cystidia 37×15 μ .

Habitat. It occurs mainly in dry, pine forests, but is observed also in deciduous forests. Summer-fall. Not frequent.

Distribution. In Poland, hitherto, found in the Carpathian foothills, near Lublin, Kuźnica Białostocka as well as near the frontier and on the area of USSR in the environs of Grodno.

Notes. This variety is characterized by the rust-red tint of the pileus and the presence of network on the entire stipe.—Plates 12, 13, 1-5.—Maublanc, 167 II.

Var. *piceicola* Vassilkov

Boletus edulis Bull. ex Fr. var. *piceicola* Vassilk. ex Vassilk., Sedobn. yad. griby, p. 40, 1948.

Pileus smooth, brown. Stipe slightly colored, frequently quite white, covered with network only on its upper half.

Habitat. Common fungus occurring in fall in spruce forests. In the Tatra Mts. observed up to 1700 m a.s.l. (Pilát). May-October.

Notes. It has been mentioned in the older Polish literature from many sites but, in view of the lack of descriptions, we cannot establish whether it concerns the typical form or its variety.

Var. *reticulatus* (Schaeff. ex Boud.) Bat.

Boletus reticulatus Schaeff. ex Boud., Bull. Mycol. Fr. 23:321, 1876.—*Boletus edulis* Bull. ex Fr. var. *reticulatus* (Schaeff. ex Boud.) Bat., Bolets, p. 14, 1908.

Boletus edulis Bull. ex Fr., var. *quercicola* Vassilkov, Sedobn. yad. griby, p. 40, 1948.

Pileus up to 23 cm in diameter, convex, very fleshy, sandy, buff, mat, delicately chamoislike, during drought sometimes aerolate. Stipe 8-11×2-6 cm, thick, sometimes bulbous, buff, of the color of the pileus or lighter, completely covered with a network. Context tough, white, under the cuticle somewhat cream-colored, invariable, with a pleasant taste and smell. Tubes almost free, depressed around the stipe or slightly adnate, white, with age—greenish. Pores small, circular, white, later olive.

Spore print olive-sandy. Spores fusiform, 12-18×4-6 μ (Fig. 33, C). Basidia 30-44×12-13 μ .

Habitat. It occurs rather frequently from May till fall in light coniferous and deciduous forests, mainly with an admixture of oaks.

Distribution in Poland. Found in Białowieża and near Kuźnica Białostocka.

Notes. It differs from the typical variety by the ochre color, the chamoislike pileus and the presence of network on the entire surface of stipe.—Plate 15, 1-2.—Konrad et Maublanc, 398.

Var. *betulicolus* Vassilkov

Boletus edulis Bull. ex Fr. var. *betulicola* Vassilk. ex Vassilk., Sedobn. yad. griby, p. 40, 1948.

Boletus carpinicola Pilát, Česka Mykol., 21:63–64, 1967.

Pileus of moderate size, light brown to sordid white. Stipe thick, short.

Habitat. Birch forests. Summer–fall.

Distribution in Poland. Found once at Chojnów near Piaseczno.

Notes. — Plate 16, 3–4.

2. *Boletus calopus* Fr.

Boletus calopus Fr., Syst. Mycol., 1:390, 1821.

[*Boletus olivaceus* Schaeff., Icon. Fung. Ind. p. 77, 1764]. — *B. pachypus* Fr., Syst. Mycol., 1:390, 1821.

Pileus up to 15 cm in diameter, fleshy, convex, with age flattened, somewhat chamoislike, light, buff-gray, milk-coffee colored, gray-beige, gray-olive. Stipe 5–8×4 cm, large, swollen, less frequently cylindrical, amaranth- or blood-red, but light yellow at the apex, covered in the upper part (yellow and red) with a whitish and in the lower part — light red network. Veil none. Context tough, thick, pale cream-colored becoming slightly blue by exposure, at the base of the stipe — sordid pink. Taste in the first moment mild, later bitter; smell slight. Tubes sinuate, relatively long, up to 1.5 cm, lemon, with age becoming olive. When touched — growing livid. Pores minute, somewhat circular, lemon, with age — olive, growing livid as tubes.

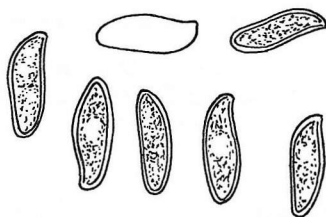


Fig. 34. Spores of *Boletus calopus* Fr. (×1000).

Spore print ochre-olive. Spores fusiform, 12–13×4–5.5 μ (Fig. 34). Cystidia mainly at the margin of tubes, colorless, fusiform, or clavate, 45–65×12–18 μ .

Habitat. It occurs in coniferous, particularly mountain, forests. Summer–fall.

Distribution in Poland. Relatively frequent in the southern part in mountain forest, rare in the center (Warsaw and Poznań voivodships) and in the north (Elbląg, Gdańsk).

General distribution. Europe, Asia.

Notes. Nonpoisonous, but in view of its bitterness not edible. The gray-beige pileus, yellow-red stipe covered with a network and the bitter taste are typical features of this fungus. — Plate 11, 4. — Kallenbach, 49.

3. *Boletus radicans* Pers. ex Fr.

Boletus radicans Pers. ex Fr., Syst. Mycol., 1:390, 1821.

Boletus amarus Pers. ex Vitt. in Cattaneo, Not. Lomb. p. 343, 1844, non Secr. (1833).

Pileus up to 30 cm in diameter, fleshy, when young — convex, chamoislike, with age somewhat flattened and shiny, light, white-gray, gray-beige, with no greenish tint, sometimes when touched becoming slightly blue. Cuticle frequently areolate, nonseparable from the context. Stipe 13–14×3–8 cm, thick, in the central part swollen, at the base considerably contracted and pointedly ended with a clod of compact mycelium; buff-yellow, gray-yellow, at the apex vivid, toward the base paler, grayish, sometimes with rust band around the stipe, when touched becoming blue, covered with a delicate network of the same color, sometimes quite smooth. Veil none. Context tough, thick, pale lemon, mostly becoming distinctly blue, in the lower part of the stipe olive-yellowish to olive-brown. The mycelial clod brown. Taste initially mild, after a moment more or less, but never very bitter. Smell slight. Tubes indented, relatively long, up to 3.5 cm long, yellow-lemon, with age olive-yellow, when touched becoming blue. Pores minute, circular-angular, lemon-yellow, with age olive-yellow, when touched becoming livid.

Spore print olive. Spores ellipsoidal-fusiform, 12–16×4–6 μ . Basidia 25–47×8–13 μ . Cystidia clavate and fusiform, colorless to yellow, 23–60×5–11 μ .

Habitat. Deciduous, particularly oak and beech, forests in warmer localities. Rare. July–October.

Distribution in Poland. Found only three times; near Wrocław, near Przesieka in the Karkonosze Mts. and in the environ of Elbląg.

General distribution. Europe, north Africa.

Notes. Nonpoisonous but not edible owing to the certain bitterness. Owing to its grayish pileus it somewhat resembles *Boletus satanas*, but it differs from the latter mainly by the bitter taste and yellow pores. — Kallenbach, 32.

4. *Boletus appendiculatus* (Schaeff. ex Fr.) Secr.

Boletus appendiculatus (Schaeff. ex Fr.) Secr., Mycogr. Suisse. 3:34, 1933.

Boletus appendiculatus Schaeff. ex (Fr.) Secr., Mycogr. Suisse. 3:34, 1933.

Pileus up to 22 cm in diameter, convex, later flattened, fleshy, dry, minutely tomentose or delicately fibrillose, yellow-brown, buff to brown with a reddish tint; in touched places acquiring a ginger color. Stipe 5–15×1–6 cm, cylindrical, sometimes ventricose and considerably contracted at the base (stipe rooting), yellow, at the apex golden-yellow, yellow-ochre, at the base brown flushed and only pinkish. Covered with

a yellow network somewhat darker and sometimes with age obliterated. Veil none. Mycelium pale yellow. Context thick, yellow, at the base of the stipe buff-brown or even somewhat pinkish, becoming blue by exposure. Taste mild, smell slight, pleasant. Tubes mostly sinuate at the stipe, up to 3 cm long, pale yellow, with age golden to olive. Pores relatively small, circular-angular, light yellow, later golden-yellow to brown-yellow. When touched becoming blue.

Spore print olive-brown. Spores ellipsoidal-fusiform, $10-15 \times 5.5 \mu$. Basidia $26-43 \times 7-12 \mu$. Cystidia clavate, sometimes fusiform-elongated, more or less yellowish, few, more numerous near pores, $32-62 \times 7-16 \mu$.

Habitat. It occurs singly in deciduous forests on light soils, particularly calcareous, especially under beeches. In mountains it reaches the altitude of 1000 m a.s.l. June–October.

Distribution in Poland. Rare species. Recorded from Silesia, near Cieszyn, Elbląg (sub *Boletus radicans*), Wałcz and Szczecin. Recently it was found by Nespiak near Jasło and by Wojewoda near Książ (1964). More to the north it has been found near Kaliningrad (USSR).

General distribution. Europe, northern Africa.

Notes. Edible. It can be readily distinguished by the yellow stipe covered with a network and the yellow context growing blue. — Kallenbach, 31 and 14, Figs. 3, 4.

(5.) *Boletus regius* Krombh.

Boletus regius Krombh. Naturg. Abb. Schw., 2:3, 1832.

Pileus up to 6–16 cm in diameter, fleshy, thick, convex, with age somewhat expanded, dry, mat, yellow or pink, covered with vinaceous or carmine hyphae, when old — yellowish or buff-red. Cuticle non-separable from the context. Stipe $5-14 \times 2-6.5$ cm, cylindrical or swollen in the central part, lemon-yellow or chrome-yellow, at the base sometimes more or less pink flushed, covered with a delicate, yellow network, sometimes growing blue. Veil none. Mycelium pale yellow. Context lemon-yellow, under the tubes yellow, under the cuticle of the pileus and at the base of the stipe somewhat pinkish, of invariable color, in the stipe slightly fibrillose; taste mild, smell pleasant. Tubes up to 3 cm long, adnate-sinuate, lemon-yellow, becoming slightly greenish, generally of invariable color. Pores minute, approximately circular, chrome-yellow, when old greenish, almost invariably not changing color when touched.

Spore print olive. Spores fusiform, $11-15 \times 4-5 \mu$. Basidia yellowish, $24-36 \times 8-12 \mu$. Cystidia colorless to pale yellow, few, more numerous near pores, clavate and fusiform-elongated, $20-70 \times 6-16 \mu$.

Habitat. On warmer sites of deciduous, mainly beech, forests. June–September.

Distribution in Poland. Hitherto not found.

General distribution. Rare species. Europe.

Notes. Edible. The following features are characteristic: fibrillose, mostly pink pileus, chrome-yellow pores, reticulate stipe and context in fact not becoming blue. The latter feature is particularly important in light, hardly pink specimens. — Kallenbach, 9, 14, Figs. 1, 2.

6. *Boletus Fechtneri* Velen.

Boletus Fechtneri Vel., Česk. houby, p. 704, 1922.

Boletus appendiculatus Schaeff. ex Fr. ssp. *pallescens* Konrad, Bull. Soc. Myc. Fr., 45:73, 1929. — *Boletus pallescens* (Konrad) Sing., Ann. Mycol., 34:424, 1937.

Pileus up to 20 cm in diameter, fleshy, convex, later flattened, tomentose then delicately silky-fibrillose, sometimes light, gray-silvery, light milk-coffee colored, when touched gradually staining brown. Cuticle nonseparable from the context. Stipe 5–13×2–6 cm, cylindrical or swollen at the base, robust in the upper part, lemon-yellow particularly in the upper part, sometimes delicately pink flushed below the middle, at the base yellow-ochre; on the upper half covered with a delicate yellow network gradually becoming paler after collecting. Veil none. Context thick, up to 3.5 cm, light lemon-yellow more vivid near the tubes and the margin of the stipe, at its base slightly pinkish; gradually becoming light blue (particularly above tubes) by exposure. Taste pleasant, smell slight. Tubes sinuate, when young vivid lemon-yellow, when old olive-yellow, becoming blue when damaged. Pores minute, circular, of similar color, becoming blue when touched (Fig. 35).

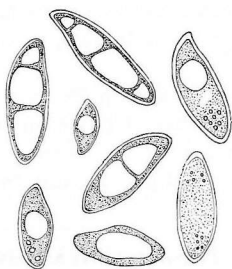


Fig. 35. Spores of *Boletus Fechtneri* Velen. (× ca 1000).

Spore print yellow-olive. Spores fusiform, 11–15×4–6 μ . Cystidia abundant on tube margins, colorless, 40–75×10–17 μ .

Habitat. It occurs singly, less frequently in groups, on calcareous soils, on warm sites of light deciduous, mainly oak and beech, forests. Relatively rare. June–August.

Distribution in Poland. Found in Pieniny Mts. in a thin fir-spruce forest belonging to *Fagetum carpaticum* (Wojewoda 1967).

General distribution. Europe.

Notes. Edible. This species is most closely related to *Boletus appendiculatus* Schaeff. ex Fr. from which it differs by the light gray pileus, lemon-yellow pores and light yellow stipe with a pink coating below its middle. From light specimens of *B. calopus* Fr. it differs by its mild taste (see also notes to *B. regius*). — Kallenbach, 43 and 14, Figs. 5, 6 (sub nom. *B. aestivalis* Fr.).

(7). *Boletus speciosus* Frost.

Boletus speciosus Frost., Bull. Buff. Soc. Nat. Sc. 2:101, 1874.

Boletus subtomentosus ssp. *cerasinus* Martin, Mat. Fl. crypt. Suisse, 2:32, 1903. — *B. fuscoroseus* Smotl., Sitzb., k.b. Ges. Wiss. 8:29, 1912. — *B. appendiculatus* var. *pseudoregius* Huber. Zeitscher. Pilzk. 6:10, 1927.

Pileus convex to flat-convex, up to 12 cm in diameter, reddish to blood-red, rarely with an olive or brown tint, when touched darkening, mat. Stipe thick, up to 15×2–5 cm, yellow with a yellow network which may transform into a delicate red punctation, at the base almost invariably with a brown or red tint and without a network. Veil none. Context white-yellowish, in some places yellow, frequently (particularly in the stipe) acquiring a pink tint, greenish or bluish flushed by exposure. Taste mild, smell slight, pleasant. Tubes up to 2 cm long, yellow, lemon, generally sinuate at the stipe, when damaged becoming intensively blue similarly as pores. Pores small, circular-angular.

Spore print olive-brownish. Spores ellipsoidal-fusiform, smooth, 9–14×3–45 μ . Basidia 20–35×6–68 μ . Cystidia clavate to fusiform, hyaline, more numerous at the margin of the pores, 36×5.5–9 μ .

Habitat. It occurs singly, less frequently in groups of several specimens, on sandy and calcareous soils, in deciduous forests, mainly under beeches. July–September.

Distribution. It is likely to be found in Poland.

General distribution. Rare species. Known in western and central Europe, but only within the range of occurrence of the beech.

Notes. Edible. — Singer 1967, 8, Figs. 17 and 20, Fig. 16.

8. *Boletus rubellus* Krombh.

Boletus rubellus Krombh., Nat. Abb. Schw. 5:12, 1836.

Boletus versicolor Rostk. in Sturm., Deutsch. Flora, 3:55, 1844. — *Xerocomus chrysenteron* (Bull. ex Fr.) Quél. var. *versicolor* Quél., Flore Mycol., p. 418, 1888. — *X. versicolor* (Bull. ex Fr.) Quél. ex Gilb., Bolets, p. 116, 1931.

Pileus 3–6–(10) cm in diameter, convex, but rapidly flattened, often irregularly curved, red-purple, cherry-red, crimson, less frequently buff-reddish or buff-pink, chamoislike or velvety, dry; during drought sometimes areolate and between red patches peach-colored. Cuticle of pileus nonseparable. Stipe 3–11×0.4–3 cm, of even thickness, frequently curved,

solid, yellow at the apex and base, in the central part red-chamoislike, in some places covered with delicate fibrils or slight punctation. When touched becoming slightly blue. Veil none. Mycelium yellow. Context soft, light yellowish, under the cuticle reddish, in the stipe yellowish, becoming light blue by exposure. Taste mild, somewhat sourish. Smell slight. Tubes 0.6–1.3 cm long, adnate, sometimes slightly decurrent or sinuate around the stipe, yellow, when old olive-yellow and olive, becoming greenish. Pores yellow, with age olive, when touched becoming greenish, large, initially labyrinthine, later of moderate size, mostly wide, angular, elongated near the stipe.

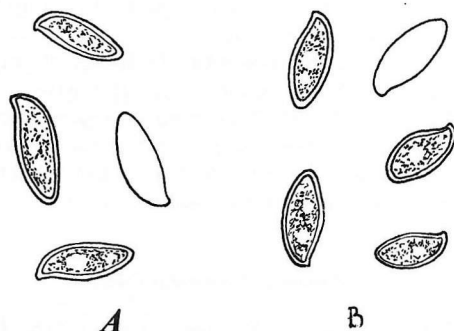


Fig. 36. Spores of *Boletus rubellus* Krombh.: A — var. *rubellus*; B — var. *armeniacus* (Quél.) comb. n. ($\times 1000$).

Spore print olive. Spores fusiform-ellipsoidal, $9-14 \times 5-6 \mu$ (Fig. 36, A). Basidia $28-52 \times 7-13 \mu$. Cystidia clavate or obtuse-pointed, $39-68 \times 8-12 \mu$.

Habitat. It occurs in groups in coniferous and deciduous, shaded forests, on humid paths, in parks. Not frequent. June–October.

Distribution in Poland. Found in the Carpathian Mts., in Silesia, in Białowieża, near Szczecin, near Gdańsk, in the environs of Kuźnica Białostocka and Ustronie in Kępno District.

General distribution. Europe, east Asia, northern Africa, North America.

Notes. Edible. Its habit resembles that of *Xerocomus chrysenteron* (Bull. ex Fr.) Quél. from which it differs mainly by the red pileus and stipe and red context under the cuticle.

Some French mycologists treat this species as a variety (var. *versicolor* Rostk.) of *Xerocomus chrysenteron* in which the red color is particularly intensive (e.g., Kühner and Romagnesi, 1953) — Plate 11, 5. — Kallenbach, 41, Figs. 1–23, 28–30.

Var. *versicolor*

Pileus never sandy nor buff-peach-colored.

Var. *armeniacus* (Quél.) comb. n.

Boletus armeniacus Quél., 13 suppl., Ass. Fr. Av. Sci.: 5, 1884 (basionym). — *Xerocomus armeniacus* (Quél.) Quél., Flore Mycol., p. 419, 1888.

Pileus 3-8(-12) cm in diameter, mat, chamoislike, dry, initially peach-colored and at the margin pink, later ochre, sandy or buff with a pink tint, when old covered with granules due to areolation. Cuticle nonseparable. Stipe 6.5-10×1.5 cm, cylindrical or somewhat swollen in the center, ochre, lighter at the apex, lower flesh-colored, at the base — yellow, smooth or somewhat chamoislike. Context flesh-colored, in the stipe yellow, in some places flesh-brick, becoming slightly blue by exposure. Taste mild, no specific smell. Tubes yellowish, later yellow-greenish and olive, adnate, sinuate, separable from the stipe. Pores yellow, with age yellow-greenish, when touched becoming somewhat blue.

Spore print rust-olive. Spores ellipsoidal-fusiform, $10.5-15 \times 5-6 \mu$ (Fig. 36, B).

Habitat. Shaded forests. Very rare. August–September.

Distribution. Found once near Kuźnica Białostocka.

Notes. Edible. The peach-colored pileus and the context becoming slightly greenish by exposure are its characteristics.

Singer (1967), with certain reservations, included it in the species *Boletus rubellus* Krombh. On the other hand, Kühner and Romagnesi (1953) claim that it is a variety (var. *armeniacus* Quél.) of *Xerocomus chrysenteron* Quél. Konrad and Maublanc (1952) stated that this fungus is poorly known and occurs in the southern and southwestern part of France. — Plate 10, 6-8. — Kallenbach 41, Figs. 24-27 (sub. *Boletus sanguineus* = *B. versicolor* Rostk.).

9. *Boletus pulverulentus* Opat.

Boletus pulverulentus Opat., Comm. Hist. Nat. Fung. Bolets, p. 27, 1836. — *Xerocomus pulverulentus* (Opat.) Gilb., Bolets, p. 116, 1931.

Pileus 4-15 cm in diameter, convex, flattened with age, sometimes flat-convex in the middle, edges sinuous, tomentose, areolate during drought, mucilaginous during rainy weather, brown-buff, later chestnut-brown, red-brown, dark-brown, gaining olive-brown tint when old, darkening when touched. Edge involute when young. Stipe 3-11×0.6-3 cm, mainly cylindrical or contracted at the base, solid, dry, tomentose when young, yellow on the apex, brown-red at the base, in old specimens covered with red-brown spots. When touched becomes dark rapidly. Veil none. Mycelium whitish to pale yellow. Context yellow, at the base of the stipe shows red tint, in the open air quickly becomes dark blue. Taste mild, smell difficult to define. Tubes up to 2 cm long, adnate, slightly lamellate decurrent, yellow, later greenish, in the open air becoming

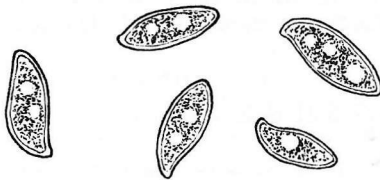


Fig. 37. Spores of *Boletus pulverulentus* Opat. (×1000). Specimen collected by Klotzsch in the environ of Berlin.

greenish. Pores pale yellow, later lemon-yellow, finally olive-yellow, dark-blue when touched, angular, rounded, often more or less irregular, elongated near the stipe.

Spore print olive. Spores elipsoidal-fusiform, $10-15(-18) \times 5(-8) \mu$ (Fig. 37). Basidia clavate, $28-44 \times 7-13 \mu$. Cystidia pale yellow to golden-yellow, clavate to fusiform, numerous near the pores $40-77 \times 6-12 \mu$.

Habitat. Singular or in small groups on the edge of the forests, in light sites, under deciduous trees; observed also under coniferous trees. Rare. June–October.

Distribution in Poland. Noted near Orłowo (Kępa Redłowska), on Uznam Island, in Silesia (Głogów, Nysa, Otmuchów, Ząbkowice Śląskie, Przesieka, Długopole, Złoty Stok—Makolno, Opolnica near Bard, Srebrna Góra). Lately Wojewoda (1964) observed it near Przemyśl in hornbeam forest.

General distribution. Europe, North America.

Notes. Edible fungus becomes intensively blue when any part of the fruit body is touched. Resembles slightly *Xerocomus badius* (Fr.) Kühn. which context slightly changes in color. — Plate 11, 2–3. — Kallenbach, 6.

10. *Boletus luridus* Schaeff. ex Fr.

Boletus luridus Schaeff. ex Fr., Syst. Mycol., 1:391, 1821.

Pileus 7–23 cm in diameter, fleshy, convex, dry, tomentose, velvety, of variable color, mostly olive, greenish-brown, but also yellow-orange and buff-red, when pressed — darkening. Cuticle nonseparable from the context. Stipe $9-15 \times 3-5(-9)$ cm, robust, cylindrical occasionally thicker at the base, dark yellow, rust to sordid red, particularly at the base, in most cases entirely covered with rust or sordid orange network (less frequently with a minute punctation). Veil none. Mycelium white-yellowish. Context tough, later soft, up to 3.5 cm thick, in the pileus flesh-

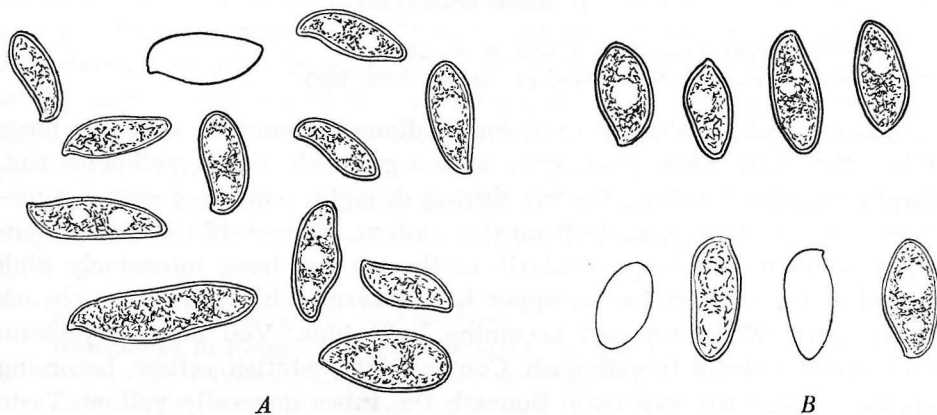


Fig. 38. A — spores of *Boletus luridus* Schaeff. ex Fr.; B — spores of *Boletus satanas* Lenz. (from the specimen collected by Schroeter in Bystrzyca Kłodzka; $\times 1000$).

yellow, in the upper part of the stipe light lemon, in the lower part — in young specimens — brick-red, in old ones — sordid red. Immediately by exposure acquiring an intensively blue, blue-green, after a while gray-green color and in the base of the stipe — with brick-red tint. Beneath the tubes — light orange. Taste mild, smell slight. Tubes up to 4 cm long, almost free, yellow-greenish when young, when old darkening, olive, becoming greenish by exposure. Pores minute, when young ochre and rust-brick-red, later — orange, when old — yellow-rust to olive. When touched becoming intensively blue.

Spore print olive. Spores ellipsoidal, $9-16 \times 6-7 \mu$ (Fig. 38, A). Basidia $21-45 \times 12-15 \mu$. Cystidia more or less yellowish, fusiform-elongated, subulate, in old specimens sometimes ramified at the apex, more numerous near the pores, $54-73-102 \times 9-14 \mu$.

Habitat. Deciduous and mixed, slightly shaded forests, particularly beneath oaks and beeches, singly or in groups of several specimens. June–September.

Distribution in Poland. All over the country on dispersed sites. Not frequent.

General distribution. Europe, northern Africa, eastern Asia, North America.

Notes. In Poland assumed as not edible, though in some cases consumed with no poisonous effects. Some authors recognize it as poisonous. It is one of the most common fungi of the so called “Hexenpilze” fungi, i.e., fungi with red pores. It exhibits a high variability. It is characterized by the rapid and intensive acquiring of a blue color of the flesh-yellow context as well as by the presence of a network on the stipe.

Singer (1967) described a Caucasian form of *Boletus luridus* Schaeff. ex Fr. and recently (1967) classified it as a separate species, called *Boletus caucasicus* (Sing.) Sing., owing to the different chemical reaction of its hyphae. This fungus was observed not only in the Caucasus, but also in Belgium and France. — Plates 17, 18, 2–4. — Kallenbach, 15, 16, 2, Fig. 5.

11. *Boletus satanas* Lenz

Boletus satanas Lenz, Schwämme, p. 67, 1831.

Boletus sanguineus Secr., Mycogr. Suisse, 3:23, 1833.

Pileus thick, fleshy, up to 30 cm in diameter, convex, with age more or less flattened, white-gray, gray with a greenish, rarely yellowish tint. Margin initially involute. Cuticle during drought somewhat shiny, sometimes areolate, nonseparable from the context. Stipe $4-17 \times 4-15$ cm, ventricose swollen, yellow particularly at the tip and base, intensively pink flushed in the middle. In the upper half covered with a distinct network mostly pink. When touched becoming light blue. Veil none. Mycelium white-cream-colored to yellowish. Context light, whitish-yellow, becoming delicately blue by exposure. Beneath the tubes generally yellow. Taste mild; smell particularly in ripe specimens, unpleasant but faint. Tubes initially short, later up to 2.5 cm long, sinuate around the stipe, when

young pale yellow, with age becoming olive, when damaged becoming blue-greenish. Pores minute, circular-angular, when young pale yellow, in ripe specimens blood-red, at the margin of the pileus often with an orange or yellow tint, with age becoming brown-olive; when touched becoming livid.

Spore print olive. Spores ellipsoidal-fusiform, $11-15 \times 5-7 \mu$ (Fig. 38, B). Basidia $25-40 \times 9-13 \mu$. Cystidia particularly numerous near pores, colorless to yellowish, clavate or ampullaceous, $27-64 \times 6-16 \mu$.

Habitat. It occurs singly or in small groups, mostly in light deciduous, particularly oak and beech, forests, in warmer regions, on calcareous soils. June–September.

Distribution in Poland. According to the older mycological literature (sometimes under the name of *Boletus lupinus* Fr.) it occurs singly all over the country, more abundantly in the south. Rare species, not observed for a number of years.

General distribution. Europe, (?) North America.

Notes. Assumed as poisonous, particularly when consumed raw. Its color resembles that of *Boletus rhodoxanthus* (Krombh) Kallenb., but this species differs from the latter by the light, yellow-pink stipe. In Poland it could have been mistaken for other species having also red pores or for *B. calopus* Fr. Thus, probably in fact the number of sites of its occurrence is smaller. It should be further sought for. — Plate 18, 1. — Kallenbach, 1 and 2, Fig. 1.

(12). *Boletus satanoides* Smotl.

Boletus satanoides Smotl., Čas. Česk. Houb., 2:29, 1920.

Pileus robust, hemispherical, later flat-convex, 6–12 cm in diameter, mat, milk-coffee to mouse-gray colored, gradually with age becoming smooth and pink-carmine, when old more brown. Stipe thick, short, $4-8 \times 2-4.5$ cm, yellow, with a punctation giving a pink to purple appearance particularly in the lower part, from the apex to $2/3$ of its length covered with a distinct, blood-red network. Veil none. Context lemon-yellow, above the tubes sulfur-yellow, rather intensively becoming blue or distinctly green by exposure. Taste mild. Smell fruitlike. Tubes adnate to the stipe, relatively short, chrome-yellow, when damaged becoming dark blue. Pores of moderate size, yellow, in most cases early becoming pink, later carmine.

Spore print olive-brown, $11-16 \times 5-6.5 \mu$, smooth, narrow-almond-shaped. Basidia $40-50 \times 8-13.5 \mu$. Cystidia (according to Bresadola) fusiform, $45-70 \times 6-9 \mu$.

Habitat. Deciduous and coniferous forests.

Distribution in Poland. In Poland, hitherto, not found.

General distribution. Europe, probably also Asia Minor.

Notes. Edible. It can be mistaken for *B. satanas* Lenz, *B. rhodoxanthus* (Krombh. ex) Kallenb., *B. caucasicus* (Sing.) Sing. or even for old specimens of *B. torosus* Fr. in Fr. et Hök. — Singer 1967, 16, Figs. 4–10.

(13). *Boletus lupinus* Fr.

Boletus lupinus Fr., Epicr., p. 418, 1838.

Pileus hemispherical, later flat-convex to flat, 6–14 cm, light gray, sometimes with a greenish shade more frequently with pink spots or patches, at the margin sometimes chrome-yellow, velvety, with age becoming smooth, mat. Stipe thick, light yellow, with age more brown or greenish, rarely with a pink tint, without network, but with zigzag bands of delicate punctation. Context yellow, particularly under the cuticle and in the upper part of the stipe, frequently with an avellaneous band in the pileus, tough, becoming distinctly blue by exposure. Taste rather unpleasant, smell light, somewhat sourish. Tubes yellow, later sordid yellow, near the stipe deep-sinuate, up to 1.6 cm. Pores minute, of similar color, later sordid scarlet, when touched becoming sordid blue, angular.

Spore print probably olive. Spores $12-16 \times 5-6 \mu$. Basidia $32-35 \times 1-13.5 \mu$. Cheilocystidia in the environ of pores, clavate or almost fusiform, pink, in bundles.

Habitat. Under beeches. September.

Distribution in Poland and notes. It is possible that it occurs in Poland since it is mentioned in the mycological literature concerning the region of this country, but it could be mistaken also for *B. satanas* Lenz. — Singer 1967, 16, Figs. 1–3.

14. *Boletus rhodoxanthus* (Krombh. ex) Kallenb.

Boletus sanguineus var. *rhodoxanthus* Krombh., Naturg. Abb. Schw., 5: pl. 37, Figs. 12–15. 1836 (nom. nud.). — *B. rhodoxanthus* (Krombh. ex) Kallenb., Zeitschr. Pilzk., 5:31, 1925.

Pileus 5–20 cm in diameter, fleshy, convex, in old specimens expanded, mat, chamoislike, light, white-gray or white-ochre with a more or less intensive pink tint; sometimes, particularly in old specimens, buff. Stipe $5-14 \times 2-6$ cm, when young rotund, with age becoming of even thickness or swollen only at the base. At the apex yellow, toward the base blood-red; completely covered with a red network. Veil none. Mycelium pale yellowish. Context light lemon, golden-yellow, under the tubes yellow, when cut becoming slightly blue. No particular smell. Tubes sinuate, up to 2.5 cm, when young yellow, later greenish-yellow and olive, when touched becoming blue. Pores somewhat circular, initially lemon-yellow, soon becoming blood-purple, somewhat lighter at the margin of the pileus, when old brown-olive, when touched becoming blue.

Spore print olive. Spores elliptical-fusiform, $10-15 \times 4-5 \mu$ (Fig. 39). Basidia $22-40 \times 7-10 \mu$. Cystidia colorless to yellowish, clavate or elongated at the tip, numerous near pores and then with a pink tint, $22-45 \times 6-10 \mu$.

Habitat. It occurs mainly in humid deciduous forests, particularly under oaks and beeches. Very rare. July–September.

Distribution in Poland. Found only five times (Białowieża, near Kuźnica Białostocka, Szczecin, Nowy Sącz and Częstochowa).

General distribution. Europe.

Notes. Assumed as poisonous, particularly when consumed raw. Beautiful fungus, with a characteristic blood-red stipe and pores. It differs from *Boletus satanas* Lenz by its intensive color of the stipe, blood-red network, yellow context and pink tint of pileus. Singer (1967, 17 Figs. 1, 2) describes a closely related fungus *Boletus torosus* Fr. in Fr. et Hök, Bol. p. 10, 1836, known in France, Switzerland and Austria. — Plate 19, 5–6. — Kallenbach, 3 and 2, Fig. 2.

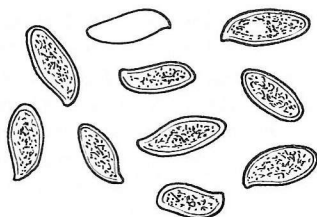


Fig. 39. Spores of *Boletus rhodoxanthus* (Krombh. ex Kallenb. (×1000).

15. *Boletus erythropus* (Fr. ex Fr.) Krombh.

Boletus luridus Schaeff. ex Fr. var. *erythropus* Fr., Syst. Mycol., 1:391, 1821. — *B. erythropus* (Fr. ex Fr.) Krombh., Consp. Fung. esc. p. 24, 1821.

Boletus miniatoporus Secr. Mycogr. Suisse, 3:28, 1833.

Pileus 5–20 cm in diameter, fleshy, convex, with age expanded, mat, tomentose, dark brown, less frequently with an olive or black tint, eventually in young specimens with a yellow-brown or orange shade. Cuticle nonseparable from the pileus. Stipe 10–15×2–6 cm, mostly cylindrical or thickened, in the lowest part light, yellow, covered instead of a network with a large number of minute grains giving the appearance of red points. When touched rapidly becoming intensively blue. Veil none. Context tough, thick, up to 2.5 cm thick, with a beautiful yellow color, immediately becoming dark blue by exposure. Smell slight, taste mild. Tubes up to

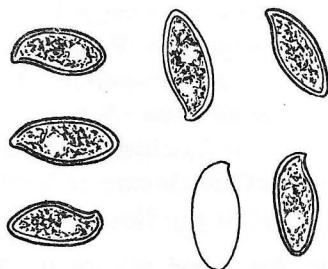


Fig. 40. Spores of *Boletus erythropus* (Fr. ex Fr.) Krombh. (×1000).

3 cm long, sinuate, when young yellow, in the course of ripening becoming olive, when damaged becoming intensively blue. Pores minute, circular-angular, yellow, with age brick-red, minium, rarely blood-red, when touched becoming blue.

Spore print sordid olive. Spores ellipsoidal-fusiform, $12(-18) \times 5(-7) \mu$ (Fig. 40). Basidia $25-45 \times 8-12 \mu$. Cystidia $40-65 \times 6-11 \mu$, widened at the apex and sometimes fusiform-elongated; occurring near pores or on the stipe, mostly more or less pink.

Habitat. Coniferous and deciduous, particularly beech and spruce, forests. In the Carpathian Mts. found at the altitude of 1600–2000 m a.s.l. (Pilát). May–October.

Distribution in Poland. Rather frequent in the mountainous southern part of the country; to the north found on Uznam Island. German literature mentions its occurrence in the Masurian Lakeland but without indication of the site.

General distribution. Europe, Asia (Asia Minor), northern Africa.

Notes. Edible after thorough boiling. It can be readily recognized by the brown, dark brick-red pores, yellow pores with the stipe red dotted at the apex and context becoming intensively blue. — Plate 19, 1–4. — Kallenbach, 30 and 2. Fig. 6 (sub nom. *Boletus miniatoporus*).

16. *Boletus queletii* Schulzer

Boletus queletii Schulzer, Hedwigia, 24:143, 1885.

Pileus 5–15(–20) cm in diameter, fleshy, convex, gradually becoming expanded, mat, somewhat pubescent, yellow-brown to olive-brown, orange, brick-red to blood-red, with all sorts of combinations of these colors. When touched becoming blue. Stipe 5–15 $\times$ 2–6 cm, cylindrical or ventricose or fusiform contracted at the base, olive to yellow particularly at the apex, at the base more or less carmine flushed, when touched becoming blue, quite smooth or delicately feltlike punctated, with no traces of network. Veil none. Mycelium pale yellowish. Context tough, more or less yellow, under the tubes yellow, at the base of the stipe reddish or dark, sordid carmine, becoming more or less blue by exposure, but not as intensively as in *Boletus erythropus* (Fr. ex Fr.) Pers. and *B. luridus* Schaeff. ex Fr., later becoming green and still later yellow. Smell slight, taste mild, sometimes sourish. Tubes up to 3 cm long, adnate or sinuate, yellow, with age olive; becoming blue by exposure. Pore rather circular or somewhat angular, when young yellow, golden-yellow, later gradually becoming orange-yellow, and finally sordid olive. When pressed becoming blue.

Spore print olive. Spores ellipsoidal-fusiform, $10-13(-17) \times 5-7(-9) \mu$. Basidia $28-40 \times 6-9(-15) \mu$. Cystidia clavate or fusiform, $40-63 \times 9-11(-15) \mu$; those occurring on the stipe with a yellow or red content, $33-42 \times 12-13 \mu$.

Habitat. Light deciduous, beech and oak forests. Mainly single. In the Tatra Mts. found at 1700 m a.s.l. (Pilát). May–October.

Distribution in Poland. Rare, observed only in the Karkonosze and Świętokrzyskie Mts. and in Złoty Potok; its site in Poznań Voivodship is uncertain since the fungus found there (in view of the lack of the author of the species) can be assumed as well as *Boletus erythropus* (Fr. et Fr.) Pers. It was also reported from the Baltic coast, but without indication of the site and under the very old name *Boletus luridiformis* Rostk.

General distribution. Europe, eastern Asia, northern Africa.

Notes. Edible. This fungus closely resembles *B. erythropus* (Fr. ex Fr.) Pers. and *B. luridus* Schaeff. ex Fr. From the former it differs by the sordid red context at the base of the stipe and context becoming light (not intensively) blue, from the latter — by the lack of network on the stipe. The pink pileus distinguishes f. *rubicundus* Maire (ut var.) Bull. Soc. Myc. Fr. 26:37, 1910. — Kallenbach, 8 and 2 Figs. 3, 4 (sub *Boletus erythropus* Pers.); Bull. Soc. Myc. Fr. (51), Atlas 46–47 (Imler).

17. *Boletus fragrans* Vitt.

Boletus fragrans Vitt., Funghi Mang., p. 153, 1835.

Pileus gray-brown, sordid honey-yellow, pale olive-flushed, up to 11 cm in diameter, tomentose, when touched purple-brown. Stipe robust, short, in the upper part yellow, later sordid lemon-colored, lower darker, of various color, with all sorts of reddish spots, light brown to quite brown. In old specimens readily separable from the pileus. Without network. Context tough, sordid white, gray-yellow, when young becoming light blue, later pale red by exposure. Taste mild, later sourish, smell of coumarin. Veil none. Tubes relatively short, yellowish, later somewhat olive, with small yellow pores becoming blue when touched.

Spores 10–15 × 4.5–5.5 μ . Basidia 30–41 × 9–11 μ . Cystidia hyaline, ellipsoidal-fusiform, 32–42 × 5–8 μ .

Habitat. Light forests. Forested meadows. Summer.

Distribution in Poland. Found only twice: in the Karkonosze Mts. and in the environ of Elbląg.

General distribution. Europe.

Notes. Edible. Gilbert (1931) claims that forms of *B. impolitus* Fr. or *B. appendiculatus* Schaeff. ex Fr. have been generally described under the name of *Boletus fragrans* Vitt. It is a species, hitherto, not sufficiently known and its systematic position is not established. Many authors classify it to the genus *Boletus*, but Konrad and Maublanc (1952) support the opinion of Quélet and classify it to the genus *Xerocomus*. — Bull. Soc. Myc. Fr., 47, pl. 45 (Peltureau).

18. *Boletus impolitus* Fr.

Boletus impolitus Fr., Epicr., p. 421, 1838.

Boletus leoninus Pers., Mycol. Eur., 2:143, 1825.

Pileus up to 20 cm in diameter, fleshy, convex, silky-tomentose, with age expanded and somewhat punctated, light sandy, buff to pale ochre, when touched becoming rust-brown. Stipe mostly robust, thick, 5–18 ×

28 cm, pale yellowish to pale lemon, later somewhat sordid, sometimes (particularly in young specimens) at the base pink or even red flushed; coarse, granular to sericeous-fibrillose, when old smoother, invariably without network. Veil none. Mycelium whitish. Context thick, up to 4 cm, whitish to pale lemon, under the tubes and on the circumference of the stipe lemon, of invariable color, in the stipe somewhat fibrous, with a mild taste, in old specimens sourish. Smell somewhat sourish, frequently somewhat carbolic. Tubes up to 3 cm long, sinuate, pale pink, with age lemon and yellow-olive, invariable. Pores angular, vivid, of the same color as tubes, not changing color when touched.

Spore print olive-ochre. Spores elliptical-fusiform, $10-15 \times 4-5.5 \mu$. Basidia $22-38 \times 7-11 \mu$. Cystidia $30-58 \times 6-14 \mu$, clavate and fusiform-elongated, hyaline to light yellowish, more numerous near pores.

Habitat. Deciduous, oak and beech forests; mainly on clay soils. Singly or in groups of several individuals. July–October.

Distribution in Poland. Found in Wisla.

General distribution. Europe, northern Africa (Algeria).

Notes. Edible. It exhibits features common for both *Boletus* and *Xerocomus*. It is characterized by: a general habit typical for *Boletus edulis*, lemon pores, invariable context, pileus staining rust when touched and granular-fibrillose stipe without network. — Plate 11, 1. — Kallenbach, 4.

(19) *Boletus junquilleus* (Quél.) Boud.

Dictyopus queletii var. *junquilleus* Quél., Ass. Fr. Av. Sci., 1897:450, 1898. — *Boletus junquilleus* (Quél.) Boud., Icon. Mycol., 4:76, 1905–1910.

Boletus pseudosulphureus Kallenb., Zeitschr. Pilzk., 2:255, 1923.

Pileus 4–18 cm in diameter, very convex, with age more or less flat-convex, with a sharp margin; initially light yellow to lemon, later more vivid, when older darker, to orange-yellow and rust-yellow, only at the margin as yellow as in young specimens; sometimes light brown with a red tint or even with carmine-brown spots. When touched immediately staining dark blue. Cuticle nonseparable. Stipe cylindrical or inversely clavate, thick, $4-11 \times 2.5-6$ cm, of similar color as the pileus, gradually becoming more vivid, without traces of network, finely and densely pubescent-punctated; when touched immediately staining dark blue. Veil none. Mycelium yellow. Context lemon-yellow (particularly in young specimens) at the base sometimes brownish to reddish, intensively and rapidly becoming blue by exposure; after longer storage frequently red flushed. Under the tubes yellow, also immediately becoming blue. No particular smell. Taste mild, sometimes slightly sourish. Tubes lemon-yellow, light, later more greenish-yellow, finally dark yellow-green; when damaged becoming intensively blue. Pores when young pale lemon, with age golden-yellow

even with a slight orange tint, later more greenish, finally sordid olive, when touched immediately becoming blue.

Spore print olive. Spores ellipsoidal-fusiform to almond-shaped, $11-18 \times 5-7 \mu$. Basidia clavate, $25-30-(59) \times 7-11 \mu$ with more or less yellow content. Cystidia lanceolate to fusiform, few, more numerous near pores, $30-63-(76) \times 5-10 \mu$.

Habitat. Beech or mixed forests with beeches. It occurs in groups of several individuals. July–October.

Distribution in Poland. Hitherto not found.

General distribution. Europe.

Notes. Kühner and Romagnesi (1953) represent the opinion that the systematic position of this species is not yet established. — Kallenbach, 5 (sub *Boletus pseudo-sulphureus*).

Genus *Tylopilus* Karst.

Tylopilus Karst., Rev. Mycol., 3:16, 1881.

Pileus convex, then expanding, mat, slightly pubescent or almost smooth, shiny, dry, during rainy weather even somewhat viscid. Stipe of the European species reticulate. Context white, changing color, but never to blue. Taste bitter (only one extra-European species exhibits a mild taste and invariable context). Tubes light (at least in young specimens), around the stipe slightly sinuate. Pores light, minute.

Spore print pink. Spores smooth. Cystidia generally well developed.

The representatives of this genus develop on ground, rarely at trunk or roots. Probably they always develop mycorrhiza with forest trees. It seems that they occur all over the world, but of the 20 species described only one is known in Europe. Some species are edible, other not, owing to their bitterness.

1. *Tylopilus felleus* (Bull. ex Fr.) Karst.

Boletus felleus Bull. ex Fr., Syst. Mycol., 1:394, 1821. — *Tylopilus felleus* (Bull. ex Fr.) Karst., Rev. Mycol., 3:16, 1881.

Pileus fleshy, convex, later flattened, up to 15 cm in diameter, light brown, chestnut-brown, dark brown with a reddish tint, sometimes on the tip covered with dark, seemingly greasy, minute spots, initially pubescent, felty, with age becoming smooth and shiny, dry, during rainy periods even somewhat viscid. Cuticle hardly separable from the context. Stipe 10–(15) $\times$ 2–4 (–6) cm, cylindrical, but mostly swollen at the base, light brown (of the color of the pileus but lighter), only at the apex cream-ochre; at least to half of its length covered with a distinct dark brown network. Veil none. Mycelium whitish. Context rather tough, white, at the base of

the stipe with a greenish tint, under the cuticle brownish, above the tubes whitish, becoming slightly pink by exposure. Smell slight, taste bitter, peppery, sometimes initially seeming mild and after a while — peppery. Tubes adnate, depressed around the stipe, 1.5–2 cm long, white, becoming flesh-pink by exposure, with age pink with a lilaceous shade, readily detachable from the pileus. Pores minute, with an even surface, almost circular later even angular, white, with age flesh-pink, when touched staining sordid flesh-color.

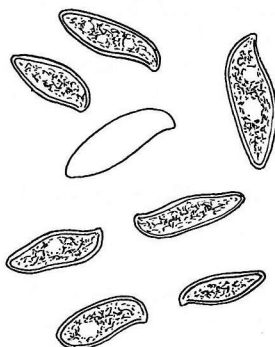


Fig. 41. Spores of *Tylopilus felleus* (Bull. ex Fr.) Karst. ($\times 1000$).

Spore print light pink to flesh-pink. Spores fusiform, $10-15(-18) \times 4-5(-6) \mu$ (Fig. 41). Basidia clavate with four (rarely two) spores, $25-39 \times 8-10(-12) \mu$. Cystidia initially clavate, with age at the apex clavate-elongated, colorless to yellowish, numerous near pores, $25-70 \times 8-13 \mu$. Hyphae without clamp connections.

Habitat. Spruce and spruce-pine, sandy, but relatively humid forests on the ground, less frequently on tree trunks. Nonpoisonous but not edible owing to its bitterness. June–October.

Distribution in Poland. Rather common in the whole country.

General distribution. Europe, Asia, North America, Australia.

Notes. Very frequently, particularly when young, mistaken for *Boletus edulis* Bull. ex Fr. It can be readily distinguished, however, by the presence of the brown network in the upper part of the stipe, pink tubes and peppery taste. Some mycologists distinguish specimens with mild taste as var. *alutarius* Fr. In Poland this variety, hitherto, has not been observed. — Plates 20, 21, 1–2. — Kallenbach, 42.

Genus *Leccinum* S. F. Gray

Leccinum S. F. Gray, Nat. Arr. Brit. Pl., 1:646, 1821, em. Snell, Mycologia, 34:406, 1942.

Krombholzia Karst., Rev. Mycol., 3:17, 1881.

Fruit bodies of moderate size or large, and fleshy, mostly on long stipes. Pileus smooth or pubescent, of various colors: from almost white,

light brown, yellow-orange to dark brown and orange, brown-olive and almost black. Stipe fibrillose, rough, with veil. Context white or less frequently yellow, invariable or changing color particularly in the stipe, but containing no boletol, with mild taste. Tubes relatively long, sinuate and almost free, yellow or white, with age gray-brown; readily detachable from the context. Pores minute, circular, of a similar color.

Spore print dark olive. Spores fusiform, mostly large (12–22 μ). Hyphae without clamp connections.

The fungi belonging to the genus *Leccinum* develop on the ground in deciduous or mixed forests, forming mycorrhiza with trees of the families *Salicaceae* and *Fagaceae*. Edible.

They occur on the North Hemisphere from the Arctic to the subtropical zones; in the tropical zone — only in high mountains. Hitherto 17 species are known several of which occur in Europe.

The genus *Leccinum* is known in the mycological literature also under the name *Krombholziella* R. Maire 1937.

KEY TO THE SPECIES

1. Pileus smooth; cuticle consisting of spherical cells (section *Scabri* Konrad et Maublanc) *L. griseum*, p. 94.
- 1*. Pileus tomentose; cuticle consisting of elongated, cylindrical cells 2.
2. Young tubes and pores yellow-lemon (section *Luteoscapra* Sing.) *L. nigrescens*, p. 95.
- 2*. Tubes and pores since young age whitish or grayish, with age becoming gray-brownish (section *Leccinum*) 3.
3. Context white, changing color initially to light lilaceous, later more or less gray. Pileus mostly more or less yellow-orange, rarely white or gray, but with a distinctly varying context *L. aurantiacum*, p. 85.
- 3*. Context white, of invariable color or hardly becoming pink. Pileus mostly light to dark brown, rarely white, generally with a greenish shade, but without orange traces *L. scabrum*, p. 89.

1. *Leccinum aurantiacum* (Bull. ex St.-Amans) S. F. Gray

Boletus aurantiacus Bull. ex St.-Amans, Fl. Ang. p. 555. 1821. — *Krombholzia aurantiaca* (Bull. ex St.-Amans) Gilb., Bolets, p. 118, 1931. — *Leccinum aurantiacum* (Bull. ex St.-Amans) S. F. Gray, Nat. Arr. Brit. Pl. 1:646, 1821.

Boletus rufus Schaeff. et aut. pl. — *B. rufus scaber* Secr., Mycogr. Suisse, 3:10, 1833. — *B. versipellis* Fr. in Hök, Bol. p. 13, 1836. — *B. floccopus* Rostk. in Sturm, Deutschl. Flora, 3(5):113, 1844. — *B. rufescens* (Secr.) Konrad, Bull. Mens. Soc. Linn. Lyon, 1:151, 1932.

Pileus 4–30 cm in diameter, hemispherical, later flat-convex and expanded, dry, mat, pubescent, generally with a free margin, an extension of the pileus cuticle, mostly yellow-orange, orange or brown-orange, less frequently white or gray with a more or less distinct orange shade. Stipe 8–22×1.5–4.5 cm, solid, cylindrical, generally thicker at the base, white, fibrillose, rough owing to numerous protruding, white, ginger, brown or gray flocci. Context tough in the pileus, rather hard and fibrous in the stipe, white, sometimes at the base of the stipe blue-greenish; becoming initially slightly pinkish and later sordid lilaceous to livid-vinaceous or slate-gray (rarely brownish) and finally more or less rapidly blackening by exposure. Taste mild. No particular smell. Tubes deep-depressed near the stipe, sometimes free, up to 3 cm long, initially white or whitish as if smoked, later gray-brown to gray-brown-olive. Pores minute, mostly almost circular, of similar color as the tubes.

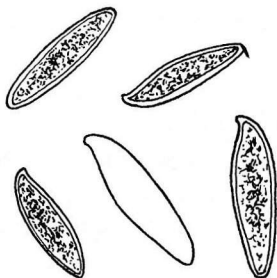


Fig. 42. Spores of *Leccinum aurantiacum* (Bull. ex St.-Amans) S. F. Gray (×1000).

Spore print dark ochre or brown-rust. Spores ellipsoidal-fusiform, elongated, large, 11–18(–22)×4.5–5.5(–6) μ (Fig. 42). Basidia 25–40×10–12.5 μ , with two or four spores. Cystidia 30–60×6–12.5 μ . Hyphae from the cuticle of pileus filamentous, with terminal cells 6–11–18(–27) μ thick. Spherocysts occurring sometimes between hyphae 15–40 μ in diameter.

Habitat. Single, rarely in groups of several individuals, on the ground in mixed or deciduous forests, in the neighborhood of aspens, birches, poplars and even oaks, less frequently in pine or spruce forests. June–October.

Distribution in Poland. Rather common in the whole country.

General distribution. Europe, Asia, North America.

Notes. Edible. It is one of the species of the genus *Leccinum* characterized by an extraordinary variability of colors dependent mostly on the habitat. Owing to

this variability individual forms have been described under various special and variety names. This variability of descriptions produced a considerable confusion in nomenclature. The names *Boletus aurantiacus* and *B. rufescens* were used most frequently. Hitherto, mycologists treated the fungi described under these names as separate species (quite valid) though closely related. Further studies based on an ample number of specimens are necessary in this respect.

Many years ago the present author (Skirgieĭlo, 1939, p. 59) advanced the opinion that these are only forms dependent on the kind of habitat. This, however, requires further analyses and a better knowledge of the range of variability.

Recently, the Russian mycologist Vassilkov (1954, 1956) carried out detailed studies and also arrived at the conclusion that we deal with a single, though greatly variable, species here. In view of this variability this author distinguished a number of forms.

Singer distinguished a closely related fungus as a separate species under the name of *Leccinum testaceoscabrum* (Secr. ex) Sing., Am. Midl. Nat. 37:123, 1947. It is characterized by an orange-yellow, dark orange-red, light red-brown pileus with a dark margin, up to 21 cm in diameter. Stipe up to 22×7 cm, from the beginning with black flocci. Context in the pileus becoming pink or also blue, in the stipe — blue (this is not visible in the figure: 1967, 23, Fig. 8). It occurs under *Betula pubescens* and other birches in the tundra and in mountains up to 2400 m a.s.l. In the Alps observed only in the subalpine zones. — Plates 21, 3–7; 22; 23. — Kallenbach, 51; Konrad et Maublanc, 408; Vassilkov (1956) 1–5.

KEY TO THE FORMS (after Vassilkov, 1956, supplemented)

1. Pileus white f. *percandidum*, p. 89.
- 1*. Pileus not white 2.
2. Flocci on the stipe white or whitish, somewhat darkening with age, but never dark brown nor black 3.
- 2*. Flocci on the stipe ginger, brown or black 4.
3. Pileus vivid red. Aspen coppices f. *aurantiacum*, p. 88.
- 3*. Pileus orange. Spruce forests f. *intermedium*, p. 88.
4. In the neighborhood of oaks. Pileus brick-red-brown f. *quercinum*, p. 88.
- 4*. In pine, birch and mixed forests 5.
5. Pileus orange. In pine or birch forests f. *arcticum*, p. 88.
- 5*. Pileus brown-yellow. Context becoming lilaceous by exposure. Pine or birch forests f. *rufescens*, p. 88.
- 5**. Pileus dark rust, purple-brown. Context in the lower part of the stipe becoming intensively blue. Mixed forests f. *vulpinum*, p. 89.

F. aurantiacum

Boletus aurantiacus Roques, Phytogr. méd., p. 23, 1821. — *Krombholzia aurantiaca* (Bull. ex St.-Amans) Gilb. — *Leccinum aurantiacum* (Bull. ex St.-Amans) S. F. Gray, Nat. Arr. Brit. Pl., 1:646, 1821.

Pileus red or more or less brown-red, flocci on the stipe when young white, with age somewhat darkening. Context in most cases rapidly becoming lilaceous. Pores when young mostly whitish.

Habitat. It occurs on relatively light, somewhat humid soils, in the neighborhood of aspens.

Distribution. In Poland found very frequently. — Plates 21, 6-7; 22. — Kallenbach, 51, Figs. 6-8, 13-16.

F. rufescens (Secr.) comb. n.

Boletus rufescens (Secr.) Konrad, Bull. Mens. Soc. Linn. Lyon, 1:151, 1932 (basonym). — *Krombholzia aurantiaca* (Roques) Gilb. f. *rufescens* (Konrad) Vassilk., Bot. mat., 11:137, 1956.

Pileus yellow-orange with various shades and even orange-brown. Flocci on the stipe black, only when young sometimes brownish. Context in most cases becoming initially pink, after a moment sordid gray or lilaceous.

Habitat. It occurs in birch and pine forests on poor soils.

Distribution. In Poland observed. — Plates 21, 3-5; 23. — Kallenbach, 51, Figs. 2-5, 10-12, 17.

F. quercinum (Pilát) comb. n.

Krombholzia rufescens var. *quercina* Pilát, Klič, p. 65, 1951 (basonym). — *Krombholzia aurantiaca* (Roques) Gilb. f. *quercina* (Pilát) Vassilk., Bot. mat., 11:138, 1956.

It resembles *f. rufescens*, except for brick-red-brown pileus. Context white, becoming pink, later gray with a violet tint by exposure. Flocci initially white, with age brown tips blackening.

Habitat. Mixed pine-oak forests, under oaks, on light and humid soils.

Distribution. Distribution poorly known. In Poland not distinguished, described in Czechoslovakia. Probably occurring also in Ukraine.

F. intermedium (Vassilk.) comb. n.

Krombholzia aurantiaca (Roques) Gilb. f. *intermedia* Vassilk., Bot. mat., 11:138, 1956 (basonym).

Pileus orange. Hymenophore when young whitish. Flocci on the stipe white. Context becoming lilaceous-gray by exposure.

Habitat. Spruce and mixed forests with spruce.

Distribution. In Poland not distinguished. Described from the European part of the Soviet Union.

F. arcticum (Lebed.) comb. n.

Boletus versipellis Fr. var. *arctica* Lebed., p. 54, 1937 (basonym). — *Krombholzia aurantiaca* (Roques) Gilb. f. *arctica* (Lebed.) Vassilk., Bot. mat., 11:138, 1956.

Pileus vivid, red-orange. Hymenophore when young gray. Stipe with brownish to black flocci. Context becoming red, later sordid lilaceous by exposure.

Habitat. Mostly in pine and birch forests of the northern forest zone and tundra.

Distribution. In Poland not found. Described in the Soviet Union. — Vassilkov 1956, 1, Fig. 3.

F. percandidum (Vassilk.) comb. n.

Boletus percandidus Vassilk., Sov. bot., 2:27, 1944 (basionym). — *Krombholzia rufescens* (Secr.) var. *percandida* Pilát, Klič, p. 65, 1951. — *Krombholzia aurantiaca* (Roques) Gilb. f. *percandida* Vassilk. Bot. mat., 11:139, 1956.

Pileus almost quite white. Hymenophore when young white or yellowish-white. Flocci on the stipe large, white, when touched darkening similarly as the pileus and pores. Context initially becoming pink and later rapidly (particularly in the stipe) dark brown, almost black by exposure.

Habitat. Pine and spruce-birch forests.

Distribution. In Poland not distinguished. Described in the Soviet Union. — Vassilkov 1956, 1, 5.

F. vulpinum (Watling) comb. n.

Leccinum aurantiacum (Bull. ex St.-Amans) S. F. Gray var. *vulpinum* Watling, Trans. Proc. Bot. Soc. Edinb. 39:197, 1961 (basionym). — *Leccinum aurantiacum* var. *vulpinum* (Watling) Pilát, Zeitschr. Pilzk. 31:9, 1961.

Pileus dark rust, purple-brown, up to 10 cm. Stipe rather robust, with brown, later darkening flocci. Context gradually becoming pink and later gray; in the lower part of the stipe — livid or dark blue.

Habitat. Mixed, deciduous-coniferous forests.

Distribution. Observed in Poland.

2. *Leccinum scabrum* (Bull. ex Fr.) S. F. Gray

Boletus scaber Bull. ex Fr., Syst. Mycol., 1:393, 1821. — *Krombholzia scabra* (Bull. ex Fr.) Karst., Rev. Mycol., 3:17, 1881. — *Leccinum scabrum* (Bull. ex Fr.) S. F. Gray, Nat. Arr. Brit. Pl., 1:647, 1821.

Pileus 15–20 cm in diameter (during great drought it may be 1.5–3 cm), hemispherical, with age more or less flat-convex or even quite flat, dry, mat, smooth or somewhat tomentose, exceptionally somewhat floccose, light to very dark brown, less frequently white or white-greenish. Cuticle nonseparable. Stipe slender, 4–15×0.4–2.5 cm, generally somewhat thicker toward the base, white, at the base somewhat greenish, fibrillose, rough owing to numerous, white, brown or black flocci. Context tough or soft, white, at the base of the stipe somewhat yellowish or white-greenish, commonly of invariable color, less frequently becoming somewhat pink or slight blue greenish. No specific taste nor smell. Tubes deep-sinuate or almost free, long (sometimes up to 3.5 cm), whitish, very rarely pinkish,

with age gray-brown readily detachable from the context. Pores minute, almost circular, white, with age sordid ochre to gray-brown.

Spore print ochre-brown. Spores ellipsoidal-fusiform, long, (8-)11-21 $\times$ 4-7(-) μ (Fig. 43). Cystidia 30-56-102 $\times$ 10-15 μ .

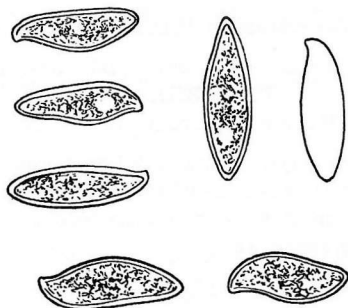


Fig. 43. Spores of *Leccinum scabrum* (Bull. ex Fr.) S. F. Gray ($\times 1000$).

Habitat. Birch or mixed coppices with single birches, on the ground, on rather humid sites.

Distribution in Poland. Common in the whole country.

General distribution. Europe, Asia, North America.

Notes. Considerably variable species with regard to its color, resembling *Leccinum griseum* (Quél.) Sing. Owing to this some older Polish mycologists did not distinguish one from the other and noted their occurrence together. In some cases it was recorded under the old name of *Boletus asprellus* Fr.

Recently, Vassilkov (1956) carried out detailed studies on this species and distinguished a number of forms. He published them, however, in an invalid way, thus the present author presents a number of combinations pointing to the necessity of more detailed studies in this respect and of a more precise consideration of the variability of this species. — Plates 24-26; 27, 7-8; 29, 1. — Vassilkow (1956), 1-6; Konrad et Maublanc, 409,

KEY TO THE FORMS

(After Vassilkov, 1956)

1. Pileus white, with age somewhat darkening. Flocci on the stipe white 2.
- 1*. Pileus not white, exceptionally whitish (f. *rotundifoliae*) . . . 4.
2. Context white, tough 3.
- 2*. Context translucent, white, soft. On afforested peatbog and in humid forests f. *chioneum*, p. 92.

3. Spores 5–7.5 μ thick. On wood *f. lignicolum*, p. 93.
- 3*. Spores 3.7–5.5 μ thick. On moderately humid soil
. *f. albidum*, p. 92.
4. Flocci on the stipe white, slightly darkening 5.
- 4*. Flocci on the stipe gray, brown to black, rarely at the tip of
the stipe white 6.
5. Context becoming slightly pink by exposure. Spores 5.5 μ
thick *f. medium*, p. 93.
- 5*. Context not becoming pink. Spores up to 7.5 μ thick
. *f. rotundifoliae*, p. 94.
6. Context becoming more or less pink 7.
- 6*. Context not becoming pink 9.
7. Pileus dark, dark gray, brown, frequently with dark and light
spots 8.
- 7*. Pileus yellow-brown, ochre-brown *f. oxydabile*, p. 93.
8. Hymenophore pinkish. Context when exposed initially trans-
lucent. Hyphae of the pileus up to 11 μ thick
. *f. versicolor*, p. 94.
- 8*. Hymenophore not pinkish. Context when exposed initially
white. Hyphae of the pileus up to 18 μ thick
. *f. roseofractum*, p. 93.
9. Pileus with ingrown fibrous flocci. In alder coppices
. *f. squamulosum*, p. 94.
- 9*. Pileus smooth or somewhat tomentose, without flocci. Not in
alder coppices 10.
10. Pileus cinnamon-colored. Hyphae from the surface of the
pileus up to 18 μ thick *f. cinnamomeum*, p. 92.
- 10*. Pileus ochre-yellow, gray-brown, black-brown. Hyphae from
the pileus generally up to 8(11) μ thick 11.
11. Pileus gray-brown, flesh-brown or brown *f. scabrum*, p. 91.
- 11*. Pileus umber, dark gray, black-brown *f. melaneum*, p. 92.

F. scabrum

Boletus scaber Bull. ex Fr., Syst. Mycol., 1:393, 1821. — *Krombholzia scabra* (Fr.) Karst., Rev. Mycol., 3:17, 1881.

Pileus generally more or less brown, flesh-brown or gray-brown. Stipe with dark to black flocci. Context invariable. Spores 3.7–6 μ thick. Hyphae from the cuticle of the pileus generally 6–11 μ in diameter.

Habitat. Mainly in birch coppices, at the edge of forests, near birches. July–September.

Distribution. Common all over Poland. — Plates 24–26, 1, 5–9; 27, 7, 8; 29, 1. — Vassilkov (1956), 1.

F. melaneum (Smotl.) comb. n.

Boletus scaber Bull. var. *melaneus* Smotl., Mykol. Sborn, 28:70, 1951 (basionym).—*Krombholzia scabra* (Fr.) Karst. f. *melanea* (Smotl.) Vassilk., Trudy Bot. Inst. AN. s. 2, 10:370, 1956.

Pileus dark, umber, gray-brown, black-brown. Flocci on the stipe gray, dark gray or black. Context invariable. Spores 3.7–5.5 μ in diameter. Hyphae from the surface of the pileus up to 9(–11) μ in diameter.

Habitat. Birch coppices, generally on more or less humid ground.

Distribution. Found in Białystok Voivodship.—Plate 26, 2–3.—Vassilkov, 1956, 5.

F. cinnamomeum (Vassilk.) comb. n.

Krombholzia scabra (Fr.) Karst. f. *cinnamomea* Vassilk., Trudy Bot. Inst. AN, s. 2, 10:370, 1956 (basionym).

Pileus up to 12 cm in diameter. Stipe with numerous minute flocci, white at the apex and black at the base. Context white, invariable or becoming slightly gray. Hyphae from the cuticle of the pileus 9–18 μ in diameter.

Habitat. Birch or mixed forests with birch. July–August.

Distribution. In Poland not observed. Described in the Soviet Union.

F. chioneum (Fr.) comb. n.

Boletus scaber Fr. var. *chioneus* Fr., Syst. Mycol., 1:394, 1821 (basionym).—*Boletus holopus* Rostk. in Sturm, Deutschl. Flora, 3(5):131, 1844.—*Krombholzia nivea* (Fr.) Gilb., Bolets, p. 118 and 184, 1931.—*Krombholzia scabra* (Fr.) Karst. f. *chionea* (Fr.) Vassilk., Trudy Bot. Inst. AN, s. 2, 10:371, 1956.

Pileus up to 4 cm, less frequently to 8 cm in diameter, white, sordid whitish, frequently a greenish tint; with age sometimes yellowish with greenish spots, during drought somewhat darkening. Flocci on the stipe white, later (particularly in old specimens) somewhat darkening. Context relatively soft, translucent-white with a greenish tint, invariable, only becoming more greenish in the stipe. Spores 13–20(–25) $\times$ 4.5–7 μ . Hyphae from the cuticle of the pileus up to 7 μ thick.

Habitat. In very humid mixed forests with a birch admixture or in birch coppices, on peatbog of various type, often in the neighborhood of birches. August–September.

Distribution. In Poland found in the Pisz Forest (Ruciane) and near Świnoujście. It should be further sought for since probably it is more propagated.—Plate 26, 4.—Konrad et Maublanc, 409 (sub. *Boletus holopus*).

F. albidum (Vassilk.) comb. n.

Krombholzia scabra (Fr.) Karst. f. *albida* Vassilk., Trudy Bot. Inst. AN, s. 2, 10:371, 1956 (basionym).

Pileus white, in some places brown-yellow (isabelline). Flocci on the stipe white. Context invariable. Spores 3.7–5.5 μ thick.

Habitat. Birch-spruce forests (nonhumid).

Distribution. In Poland not distinguished. Described from the European part of the Soviet Union.

F. lignicolum (Vassilk.) comb. n.

Krombholzia scabra (Fr.) Karst. f. *lignicola* Vassilk., Trudy Bot. Inst. AN, s. 2, 10:371, 1956 (basionym).

Pileus and flocci on the stipe whitish. Context tough. Terminal hyphae from the cuticle of the pileus 5–7.5 μ thick. Spores 14–19 $\times$ 5–7.5 μ .

Habitat. On aspen trunks. September.

Distribution. In Poland not found. Described from the environs of Leningrad.

F. medium (Vassilk.) comb. n.

Krombholzia scabra (Fr.) Karst. f. *media* Vassilk., Trudy Bot. Inst. AN, s. 2, 10:371, 1956 (basionym).

Pileus brownish, grayish-brownish. Flocci on the stipe white (whitish), with age somewhat darker. Context white, becoming slightly pink by exposure. Hyphae from the surface of the pileus up to 8 μ thick. Spores 4–4.5 μ thick.

Habitat. Drained boggy birch coppices. Among *Calamagrostis lanceolata*. August.

Distribution. In Poland not observed. Described from the European part of the Soviet Union.

F. roseofractum (Sing.) comb. n.

Krombholzia scabra (Fr.) Karst. f. *roseofracta* Sing. Ann. Mycol., 1–2:36, 1942 (basionym).

Pileus dark gray, brown or spotted (spots dark and almost white). Stipe generally swollen at the base, with dark gray, large flocci. At the base flocci generally greenish. Context white, becoming more or less pink by exposure, at the base of the stipe partly blue-green.

Spores 5–7.5 μ thick. Hyphae from the surface of the pileus up to 18 μ thick.

Habitat. Humid, light birch coppices, drained peatbogs. August–September.

Distribution. In Poland not observed. Described from the Soviet Union and Finland. — Vassilkov, 1956, 1, 5.

F. oxydabile (Sing.) comb. n.

Krombholzia oxydabilis Sing., Zeitschr. Pilzk., 16:18, 1838 (basionym). — *Leccinum oxydabile* (Sing.) Sing., Am. Midl. Nat., 37:123, 1947.

Pileus large, up to 15 cm, yellow-brown, with age brown-umber. Stipe up to 12 $\times$ 3 cm, with large, dark, finally black flocci. Context tough, white, becoming intensively pink particularly in the upper half and — sordid gray in the lower. Spores 4.5–6.7 μ . Hyphae from the cuticle of the pileus 8–18(–22) μ thick.

Habitat. In the neighborhood of birches.

Distribution. In Poland not found. Described from the Altai and European part of the Soviet Union as well as from North America.

Notes. In Singer's opinion this form is a separate species. — Singer 1967, 21, Figs. 14–16.

F. versicolor (Vassilk.) comb. n.

Krombholzia scabra (Fr.) Karst. f. *versicolor* Vassilk., Trudy Bot. Inst. AN, s. 2, 10:373, 1956 (basionym).

Pileus of nonuniform color, with brown and almost white spots. Flocci on the stipe dark grayish. Context translucent-white, becoming pink by exposure, at the base of the stipe bluish. Hymenophore sordid pinkish. Spores $4.5-6\ \mu$ thick. Hyphae from the cuticle of the pileus up to $9(-11)\ \mu$ thick.

Habitat. Found only once on peatbog near *Betula tortuosa*.

Distribution. In Poland not found. Described from the Soviet Union.

F. rotundifoliae

Krombholzia rotundifoliae Sing., Schweiz, Zeitschr. Pilzk., 16:18, 1938 (basionym). — *K. scabra* (Bull.) Karst. ssp. *rotundifoliae* Sing., Rev. Mycol. 5:12, 1940. — *Krombholzia scabra* (Fr.) Karst. f. *rotundifoliae* (Sing.) Vassilk., Trudy Bot. Inst. AN, s. 2, 10:372, 1956.

Pileus up to 7 cm in diameter, pale ochre-gray, light brown, almost whitish, when old or during drought somewhat darker. Stipe relatively thin and short, $5-7 \times 0.5-0.7$ cm. Flocci on the stipe white, with age darkening. Context white, invariable. Spores $17-23 \times 4.5-8\ \mu$. Basidia $20-26 \times 9-12\ \mu$. Hyphae from the cuticle of the pileus up to $7(-9)\ \mu$ thick.

Habitat. In mountains in the alpine zone, less frequently in thin, humid, birch-pine forests of the temperate zone, among peat mosses, haircaps and other mosses, in the neighborhood of trees such as *Betula nana* and *B. pubescens*. July–August.

Distribution. In Poland not found. Recorded from northern Asia, Maryiskaya Republic (USSR), North America and Europe. Recently, Pilát (1971) found it in northern Norway and assuming it as a separate species he calls it *Leccinum rotundifoliae* (Sing.) A. G. Smith, Thiers et Walting. — Vassilkov (1956), 4.

F. squamulosum (Vassilk.) comb. n.

Krombholzia scabra (Fr.) Karst. f. *squamulosa* Vassilk., Trudy Bot. Inst. AN, s. 2, 10:372, 1956 (basionym).

Pileus up to 7.5 cm in diameter, greenish-brown, in the center dark brown, covered with ingrown flocci. Stipe 10×1 cm, with minute, dark flocci. Spores $14-18 \times 5-7.5\ \mu$. Hyphae from the surface of the pileus $7-16\ \mu$.

Habitat. Alder copices. September.

Distribution. In Poland not found. Described from the European part of the Soviet Union.

3. *Leccinum griseum* (Quél.) Sing.

Gyroporus griseus Quél. Ass. fr. Av. Sc. (1901): 495, 1901 (basionym). — *Leccinum griseum* (Quél.) Sing. Die Röhrlinge 2:89, 1967.

Boletus duriusculus Schulz. in Fr., Hym. Eur. p. 515, 1874. — *Leccinum duriusculum* (Schulz.) Sing., Am. Midl. Nat., 37:122, 1947. — *Boletus pseudoscaber* Kallenb., Pilze Mitteleur., p. 117, 1935, non Secr. (1833).

Pileus initially hemispherical, later expanded, more or less flat-convex, rarely flat, 4–15 cm in diameter; ochre, more or less yellowish-

greenish, gray-olive, brown-olive, rare almost quite brown or black (mostly old specimens); during drought in places minutely cracked. Surface frequently uneven, as if radially rugose. Cuticle nonseparable. When touched seemingly humid. Not viscid. Stipe hard, slender, $5-16 \times 1-4$ cm, rough owing to numerous flocci, in old specimens almost black. Context tough, in the stipe more or less fibrillose, whitish, immediately becoming more or less pink and after a while violet-gray and finally blackening by exposure; at the base sometimes becoming slightly green. No specific taste nor smell. Tubes up to 3 cm long, whitish, white-grayish, with age olive-brown, when damaged staining initially violet-gray, later black. Pores minute, whitish, gray-yellowish, finally olive-grayish, when touched becoming gray and black.

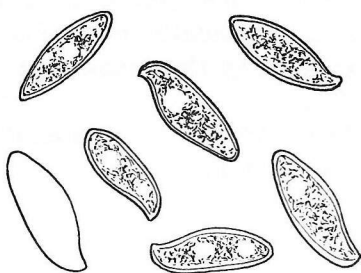


Fig. 44. Spores of *Leccinum griseum* (Quél.) Sing. ($\times 1000$).

Spore print sandy-ferrugineous, sordid brown. Spores ellipsoidal to fusiform $14-21 \times 5.5-7 \mu$ (Fig. 44). Basidia $24-38 \times 8-12.8 \mu$. Cystidia $48-85 \times 10-16 \mu$. Cuticle of pileus made of spherocysts $20-40 \times 25-30 \mu$.

Habitat. Deciduous, particularly hornbeam-beech and birch forests. June–October.

Distribution in Poland. Rather common in the whole country. July–September.

General distribution. Europe.

Notes. Edible. For a considerable period it was mistaken for *Leccinum scabrum* (Bull. ex Fr.) S. F. Gray. It differs distinctly from the latter by the red context, olive tint of the pileus and by the presence of isodimetric cells in the cuticle of the pileus. It is also known under the following names: *Boletus carpini* R. Schulz and *Krombholzia rugosa* (Fr.) Pilát.—Plate 27, 1–6; 28—Kallenbach, 40 (sub *Boletus pseudoscaber*).

4. *Leccinum nigrescens* (Rich. et Roze) Sing.

Boletus nigrescens Richon et Roze, Atlas Champ., p. 191, 1888.—*Leccinum nigrescens* (Rich. et Roze) Sing., Am. Midl. Nat., 37:116, 1947.

Boletus rimosus Vent., Mic. Agr. Bresc., p. 48, 1963.—*B. tessellatus* Gilb., Champ. Fr. Hymen., p. 636, 1878, non Rostk. in Sturm (1844)—*Krombholzia crocipodia* (Lettell. p. p. ex) Gilb., Bolets, p. 118, 177, 1931.

Pileus 5-16(-20) cm in diameter, hemispherical, later more or less convex, initially olive-yellow, gradually becoming more vivid, lemon-yellowish, brownish with an orange tint, finally dark, sordid brown, somewhat darkening when pressed; cuticle felty, frequently more or less areolate. Stipe 15-19×1.5-5 cm, somewhat thicker in the central or lower part, but generally with a fusiform end; light, lemon-yellow, with age more or less darkening; rough owing to minute, yellowish flocci, forming in the upper part a kind of ribs joining even into a kind of network. Context soft, in the stipe hard, fibrillose, very light, lemon-yellowish, mostly becoming more or less intensively pink and soon blackening by exposure; sometimes with a lilaceous or bluish tint; under the tubes yellowish. Mycelium yellowish. No specific taste nor smell. Tubes very long, deep-depressed around the stipe, lemon-yellowish, gray-yellowish to olive-yellowish, sometimes becoming slightly pink. Pores somewhat circular-angular, dense, of similar color as the tubes, somewhat darkening under pressure.

Spore print sordid brownish. Spores ellipsoidal-fusiform, 12-18×6-8 μ . Basidia 21-31×6-12 μ . Cystidia clavate, with fusiform tips, agglomerated near pores, 30-62×5-11 μ .

Habitat. Light deciduous forests, under beeches and oaks. July-September.

Distribution in Poland. Very rare, recorded from only several localities (Szczecin, Dębek near Żarnowiec — birch coppices and Rowy between Ustka and Łeba).

General distribution. Europe, north Africa.

Notes. Edible. Maybe, this fungus with characteristic lemon pores occurs more frequently, but has not been observed owing to its similarity to *Leccinum aurantia-cum* (Bull. ex) S. F. Gray. — Kallenbach, 7 (sub *Boletus rimosus*).

FAMILY STROBILOMYCETACEAE

Fungi with fleshy, relatively large, up to 15 cm in diameter (European species) fruit bodies, consisting of a pileus and central stipe. Pileus covered with thick squamae and flocci, occasionally also pubescent or smooth; dry, in some species glutinous. Stipe relatively long, cylindrical, smooth or covered with fibrillose, minute flocci and partly even with a delicate network. Some species with a membranaceous or woolly, sometimes slightly viscid or disappearing, veil; the veil generally droops from the stipe in the form of an annulus or from the margin of the pileus in the form of sordid white shreds. Hymenophore consisting of relatively long tubes, when young gray-cream-colored, adnate, when ripe becoming sordid brown with a reddish shade; pores of similar color, only in extra-European

species more vivid, sometimes orange to red. Context tough, white, becoming pink or blackening by exposure.

Spore print pink-brown, purple to almost black. Spores with darker ornamentation or smooth. Basidia with four spores. Cystidia relatively thick. Hyphae without clamp connections.

Fungi belonging to this family develop mainly in tropical or subtropical countries, on ground, less frequently at the base of trees or on rotten trunks. A total number of 28 species are known and grouped in three genera, one of them is known in Europe.

KEY TO THE GENERA

1. Pileus covered with thick scales. Veil present. Spores almost spherical, reticulate *Strobilomyces*, p. 97.
- 1*. Pileus smooth, pubescent. Veil none. Spores ellipsoidal-fusiform, smooth *Porphyrellus*, p. 98.

Genus *Strobilomyces* Berk.

Strobilomyces Berk., Dec. Fungi. 32-33, Hook, Journ. Bot., 3:77, 1851.

Pileus fleshy, compact, covered with flocci agglomerated into large, protruding, imbricate scales. Stipe central, compact, relatively hard, fibrous, covered with minute squamae. Veil partial, after disruption forming cottony flocci drooping from the margin of the pileus or forming an annulus around the stipe. Context compact, white, becoming pink or red by exposure.

The species of this genus are relatively well known. Of the nine, hitherto described species, only one occurs in Europe.

1. *Strobilomyces floccopus* (Vahl ex Fr.) Karst.

Boletus floccopus Vahl in Fl. Dan. ex Fr., Syst. Mycol., 1:292, 1821. — *Strobilomyces floccopus* (Vahl ex Fr.) Karst., Bidr. Finl. Nat. Folk, 37:16, 1882.

Boletus squarrosus Pers., Mycol. Eur., 2:145, 1825. — *B. strobilaceus* Scop. ex Fr., Elench., 1:127, 1828. — *Strobilomyces strobilaceus* (Scop. ex Fr.) Berk., Dec. Fung. 32-33, Hook. Journ. Bot., 3:77, 1851; Outl. Brit. Fungol., p. 236, 1860.

Pileus initially hemispherical, with age somewhat less convex, up to 15 cm in diameter, covered with large, silky-woolly flocci arranged into thick, imbricate scales; tips of scales protruding from the pileus. Scales at the base dark gray with a pink-lilaceous tint, in the upper part —

sordid brown to black. Generally, in ripe specimens, shreds of a whitish veil droop from the margin of the pileus. Stipe 10–15×1–2 cm, central, cylindrical, fibrous-fleshy, of the same color as the pileus, only at the apex whitish, covered with gray flocci below the annulus and ribbed-reticulate in the upper part. Veil woolly, thick, whitish, adnate to the stipe and to the pileus and in most cases early disrupted into shreds. Context compact, white, with age somewhat reddish to dark brown. Becoming red by exposure. Taste pleasant. Tubes long, adnate or slightly decurrent, white, with age gray-brown with a reddish tint. Pores large, angular, whitish, with age gray, becoming red, later blackening when touched.

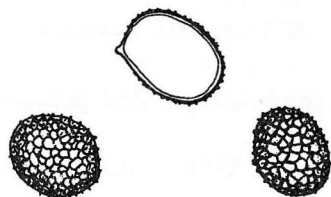


Fig. 45. Spores of *Strobilomyces floccopus* (Vahl ex Fr.) Karst. (×1000).

Spore print brown-purple. Spores spherical or almost spherical, with a single drop, reticulate, 10–16×8.5–12.5 μ (Fig. 45). Basidia colorless to light brown, 30–40×10(–16) μ . Cystidia colorless or light brown, clavate, less frequently pointed at the tips, 60–75×14–19 μ , occurring on the entire surface of the tubes.

Habitat. It grows mainly in mountainous regions, in shaded, mostly deciduous, less frequently coniferous forests, on fertile soils. August–October.

Distribution in Poland. Rare. Hitherto, noted only in mountainous regions, in Silesia, Little-Poland Highland, from the environs of Warsaw, Gdańsk, Wałcz and Elbląg as well as from the Masurian Lakes (Biszynek, Dobre Miasto, Wołowo).

General distribution. Europe, Asia, North America.

Notes. Edible and without reason suspected to be poisonous. It can be readily distinguished by the large scales on the pileus and reticulate, almost spherical spores. —Plate 29, 4. —Konrad et Maublanc 396.

Genus *Porphyrellus* Gilbert

Porphyrellus Gilbert, Bolets, p. 99, 1931.

Pileus smooth or pubescent, in the European species dark. Stipe central, smooth or pubescent, somewhat ribbed, partly even delicately reticulate, but not fibrillose floccose; veil none. Context whitish, changing color. Tubes and pores in young fruit bodies gray-cream-colored, with age sordid brown, becoming pink or red by exposure.

Spore print brown-purple. Spores large, fusiform.

Overground fungi, mainly occurring in North America, Asia and Australia. Of the eight species described only one has been observed in Europe.

1. *Porphyrellus pseudoscaber* (Sacr.) Sing.

Boletus pseudoscaber Sacr., Mycogr. Suisse 3:13, 1833. — *Porphyrellus pseudoscaber* (Sacr.) Sing., Farlowia 2:115, 1945.

Boletus porphyrosporus Fr. in Hök, Boleti, p. 13, 1836. — *Tubiporus porphyrosporus* Ricken, Vademecum, ed. I, p. 205, 1918; ed. II, p. 214, 1920. — *Porphyrellus porphyrosporus* (Fr.) Gilb., Bolets, p. 99, 1931.

Pileus thick, fleshy, intensively convex, later flattened, up to 16 cm in diameter, dry, velvety, tomentose, during drought areolate, initially gray, later gray-olive, olive-brown to dark brown with a reddish tint, darkening when touched. Stipe solid, relatively hard, 4–16×1–4 cm, of the same color as the pileus, in the upper part darker, at the base lighter; darkening when touched; initially bulbous, with age becoming more or less uniformly thick, tomentose, with delicate, longitudinal ribs, veins and punctation (on the lighter background of the cuticle). Context initially relatively hard, white, with age soft and yellowish, later sordid, staining blue-greenish, finally brown-blackish; in the stipe more or less fibrous. Mycelium white. Taste rather unpleasant, sometimes peppery. Smell sourish. Tubes long, up to 2.5 cm, adnate, gray, later gray-brown, darkening, frequently becoming blue or red when touched. Pores relatively large, irregular, circular to angular, gray-olive, darkening when touched.

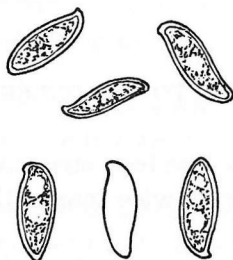


Fig. 46. Spores of *Porphyrellus pseudoscaber* (Sacr.) Sing. (×1000).

Spore print purple-brown. Spores yellowish to brownish, ellipsoidal-fusiform, granular, smooth, 13–19(–21)×6–7 μ (Fig. 46). Basidia 34–51×13–15 μ . Cystidia clavate, vesicular or elongated at the tip to fusiform, colorless or yellow to brownish, 30–90×18–25 μ , numerous near pores. Hyphae of the stipe without clamp connections.

Habitat. It occurs singly or in small groups on sandy soils in coniferous and mixed forests, under pines, spruces and firs, mainly in mountain forests, reaching the altitude of 1400 m a.s.l. (Pílat).

Distribution in Poland. Rare, found in the southern regions, in the mountains and noted in the environs of Gdańsk. June–October.

General distribution. Europe, Asia, North America.

Notes. Edible, though of secondary value. It can be readily distinguished by the purple spore print and large, irregular, angular pores. — Plate 13, 1. — Kallenbach, 26.

FAMILY PAXILLACEAE

The family *Paxillaceae* includes few fleshy fungi with delicately pubescent pilei, filamentous sometimes viscid during rainy weather, with involute margins in young specimens. Stipe invariably solid. Hymenophore lamellate, but lamellae more or less anastomosing particularly near the stipe and owing to this even a kind of delicate network may develop on the stipe. Lamellae yellow or whitish to ochre. Spores smooth, oval, ellipsoidal or elongated. Basidia with four spores. Cystidia present or none. These fungi occur on all the continents, on the ground or on rotten wood. They do not develop mycorrhiza. A total number of 13 species is, hitherto, known.

The representatives of the family *Paxillaceae* are an intermediate form between the families *Agaricaceae* and *Boletaceae*. They resemble the former by their general habit and the latter — by the presence of numerous anastomoses forming a kind of porous hymenophore.

KEY TO THE GENERA

1. Lamellae sparse, thick, at the base anastomosing or joined with ribs, golden-lemon. Spores twice longer than their width *Phylloporus*, p. 105.
- 1.* Lamellae dense, near the stipe anastomosing, pale yellowish to ochre; never goldish. Spores at the utmost twice as long as their width *Paxillus*, p. 100.

Genus *Paxillus* Fr.

Paxillus Fr., Fl. scan. p. 339, 1835. — *Rhymovis* Rabenh., Kryptogamenfl., 1:453, 1844. — *Tapinella* Gilb., Bolets. p. 67, 1931.

Large fungi, up to 5–30 cm in diameter. Pileus tomentose to velvety, only after rain viscid, light buff to brown and olive-brown, with a central,

excentric, less frequently lateral, sometimes tomentose stipe. Lamellae pale yellow to ochre, anastomosing especially near the stipe. Context with a mild taste.

Spore print ochre. Spores obovate to elongated. Cystidia present or none. Clamp connections none. The representatives of this species develop on ground or on rotten wood; of the 12 species known, six occur in Europe.

KEY TO THE SPECIES

1. Large fungi, up to 30 cm high. Stipe thick, short, brown, tomentose or velvety. Spores 5–7 μ long *P. atrotomentosus*, p. 102.
- 1*. Smaller fungi, up to 15 cm high. Stipe (if any) neither tomentose nor thick 2.
2. Stipe generally none; pileus lateral. On wood 3.
- 2*. Stipe central (or excentric). On ground or on wood 4.
3. Spores 4–6 μ long. Cystidia none. Pileus and stipe without traces of violet. Lamellae anastomosing *P. panuoides*, p. 103.
- 3*. Spores 6–7 μ long. Center of the pileus and stipe with a violet tint. Lamellae at the base of the pileus of merulioid character *P. ionipus*, p. 104.
4. Stipe relatively long, about 5 cm. Pileus tomentose, less frequently smooth. Cystidia present *P. involutus*, p. 101.
- 4*. Stipe very short, 2–2.5 cm. Pileus with minute flocci. Margin involute. Cystidia none. Coniferous forests *P. polychrous*, p. 105.
- 4**. Stipe short, up to 3.5 cm. Pileus fibrillose, owing to fissures in patches. Margin noninvolute. Under alders . . . *P. tomentosus*, p. 104.

1. *Paxillus involutus* (Batsch ex Fr.) Fr.

Paxillus involutus (Batsch ex Fr.) Fr. Epicr., p. 317, 1838.

Pileus 5–15(–20) cm in diameter, convex, flat, with depressed center and strongly involute margin, for a long period tough, sordid ochre, ochre-rust, mostly brown, rust brown, buff, olive-brown, tomentose particularly at the margin, early becoming smooth and even shiny (dry) and viscid during rainy weather. Stipe 5(–8) $\times$ 1–2.5 cm, relatively short, central or somewhat excentric, thickened upward, smooth, slightly lighter than

the pileus. Context yellowish, brownish, with no specific smell; taste mild, somewhat sourish. Lamellae decurrent, numerous, dense, olive-ochre, olive-brownish, becoming brown when touched, forked and anastomosing at the stipe; readily detachable from the pileus.

Spore print ochre. Spores $8-10 \times 4.5-6 \mu$, ellipsoidal (Fig. 47). Basidia $31 \times 8-9 \mu$. Cystidia $34-65 \times 13-20 \mu$.

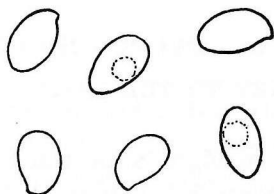


Fig. 47. Spores of *Paxillus involutus* (Batsch ex Fr.) Fr. ($\times 1000$).

Habitat. In humid forests and parks, sometimes on open areas, on marshy soils or on rotten wood. July–October.

Distribution in Poland. Common in the whole country.

General distribution. Europe, North America.

Notes. Edible after blanching (when raw noxious), mostly used pickled. This species has caused poisoning. Pilát observed in the Tatra Mts. a thin-stipe variety, var. *leptopus* Fr., characterized by a short, inclined, excentric stipe intensively yellow pileus and more lemon context. — Plate 30, 2. — Maublanc, 152.

2. *Paxillus atrotomentosus* (Batsch ex Fr.) Fr.

Agaricus atrotomentosus Batsch ex Fr., Syst. Mycol., 1:272, 1821. — *Paxillus atrotomentosus* (Batsch ex Fr.) Fr., Epicr., p. 317, 1838.

Pileus large, 10–30 cm in diameter, thick, fleshy, initially convex, with age somewhat infundibuliform-depressed, dry, pubescent, buff, avel-laneous-brown, with an involute margin particularly in young specimens. Stipe short, $5-6 \times 2-4$ cm, robust, excentric or lateral, entirely covered with a dark brown tomentum. Context thick, soft, whitish, with a mild but unpleasant taste. Lamellae pale yellowish, with age ochre, decurrent, forked or anastomosing at the stipe; readily separable from the context.

Spore print pale ochre. Spores $5-7 \times 4-4.5 \mu$, almost hyaline, elliptical (Fig. 48, A). Cystidia none. Clamp connections present.

Habitat. On rotten, mainly pine trunks and roots; observed also on trunks of deciduous trees. July–October.

Distribution in Poland. Not common, but singly occurring in the whole country.

General distribution. Europe, America.

Notes. Edible, but of secondary value. It can be readily identified owing to its large size and characteristic, tomentose, woolly-velvety, dark brown stipe. — Plate 30, 3. — Maublanc (1952) 153; Lange, 134 D.

3. *Paxillus panuoides* (Fr. ex Fr.) Fr.

Agaricus panuoides Fr. ex Fr., Syst. Mycol. 1:273. 1821. — *Paxillus panuoides* (Fr. ex Fr.), Epicr., p. 318, 1838.

Rhymovis panuoides Rabenh., Kryptogamenfl., 1:453, 1844. — *Paxillus acheruntius* (Humb. ex) Schroet., Jhrb. Schles. Ges. 1884, p. 300, 1885. — *Tapinella panuoides* Gilb., Bolets, p. 67, 1931. — *Crepidotus panuoides* Fr. in Pilát, Monogr. *Crepidotus*, p. 18, 1948.

Pileus up to 8 cm in diameter, hemispherical, conchate, elongated, sometimes cupuliferous, sessile, less frequently lateral on a short stipe, woolly particularly at the margin, later only pubescent, finally smooth, pale yellowish, ochre, sordid ochre, with age somewhat darker; margin involute, later somewhat flexuose and lobate. Stipe none, but if any, hardly visible, lateral, of the same color as the pileus. Context thin, soft, whitish to cream-colored; taste mild; no specific smell. Lamellae considerably dense, decurrent mostly to a single excentric point, flexuose, anastomosing particularly at the base, less frequently only forked, yellow, with age buff; readily detachable from the context.

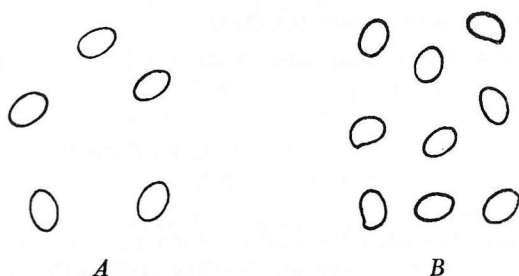


Fig. 48. A — Spores of *Paxillus atrotomentosus* (Batsch ex Fr.) Fr. ($\times 1000$); B — spores of *P. panuoides* (Fr. ex Fr.) Fr. ($\times 1000$).

Spore print pale brown. Spores $4-6 \times 3-4 \mu$, ochre, wide-ellipsoidal, with a granular content, in mature age generally with a single drop (Fig. 48, B). Basidia $19-26 \times 4.5-6 \mu$. Cystidia none.

Habitat. On rotten trunks and dry twigs of coniferous, less frequently, deciduous trees, also in cellars, wells, mines, etc. where it develops normal fruit bodies. Generally it occurs in groups or clusters, sometimes imbricately developing. Mainly July–November.

Distribution in Poland. Hitherto, noted from Silesia, Rawicz, Nadola near Żarnowiec, from the environs of Wągrowiec, Warsaw, Skierniewice, Międzyrzec and Wojciechów near Włodawa.

General distribution. Almost common.

Notes. Edible. A species with a varying shape and its generic status is not yet established. A great majority of mycologists classify it to the genus *Paxillus* with which it is connected by certain common features. On the other hand Pilát (1948) includes it into the genus *Crepidotus* Fr. with which it has also common features. — Konrad et Maublanc, 391; Lange 134 B.

The following three forms are reported from Czechoslovakian mines: f. *crispa* Pilát, with a sessile pileus or short stipe and deep-indented, flexuose margin; f. *pezizoides* Pilát, with small (1–2 cm), resupinate fruit bodies growing on pit-props, abundant in mines; f. *campanulata* Pilát, with as small fruit bodies, on extremely elongated (stringlike) stipes, far less frequent.

(4) *Paxillus tomentosus* Fr.

Paxillus filamentosus Fr. Epicr. p. 317, 1838.

Paxillus leptopus Fr. Mon. Hymen. Suec, suppl. 2:311, 1864.

Pileus 2–7 cm, flat or somewhat depressed, with an incurved margin, brown-olive, seemingly scaly to villose, with age areolate into longitudinal flocci among which a yellowish background is visible, giving a motley appearance of the surface. Stipe central or excentric, $1.2\text{--}3.5 \times 0.3\text{--}0.6$ cm, of similar color as the pileus. Context soft, lemon-yellow, at the base of the stipe rust-brown. Taste slightly sourish. Smell not distinct. Lamellae at their base connected with ribs, when young golden-yellow, dichotomic, free; becoming red-brown when touched.

Spores $7\text{--}7.5 \times 4\text{--}4.5$ μ (but also $9\text{--}10 \times 4\text{--}5.5$ μ), ellipsoidal, smooth, containing a single large drop.

Habitat. Very humid forests of the *Fraxino-Carpinetum* type, under *Alnus incana*, *Fraxinus excelsior* and *Sambucus nigra*.

Distribution. Europe.

Notes. This fungus has been thoroughly studied by Kotlaba and Pouzar (1962) who decided that it is a separate species. Watling (1970) calls it "misidentification."

(5) *Paxillus ionipus* Quél.

Paxillus ionipus Quél., Bull. Ass. Fr. Av. Sci., 16, suppl., p. 2, 1887.

Pileus 5–10 cm long and 3–4.5 cm wide, conchate, oval or elongated, velvety, light ochre, in the center somewhat darker, partly with a violet tint. Stipe lateral, short, thick, $1\text{--}1.5 \times 1$ cm, felty, amethystine. Context pale yellowish, in the lower part light yellow. Smell slight, resembling that of apricots. Taste somewhat sourish. Lamellae free from the stipe, light ochre, in the lower half of the fruit body connected with transverse ribs giving a merulioid character.

Spores yellow-brown, 6–7 μ .

Habitat. On wood.

Distribution. In Poland not observed. Hitherto, recorded in France and Czechoslovakia. Moser (1967) following Quélet assumes it as a violet-stiped variety of *P. panuoides* (Fr.) Fr.

(6) *Paxillus polychrous* Sing.

Paxillus polychrous Sing., Rev. Mycol., 2:226, 1937.

Pileus 2–7.5 cm in diameter, convex, later somewhat depressed, dry, covered with thick, minute, brown flocci lying in a lighter background; margin smooth, involute; terminal cells on the scales clavate, partially brown incrustated, 6.5 μ long. Cuticle containing olive, mostly cubic, crystalline formation. Stipe generally 2–2.5 $\times$ 0.9–1 cm, central, lateral or excentric, of even thickness, brown pubescent with a lilaceous tint. Lamellae dense, decurrent, olive-yellow, when drying somewhat blackening, 3 mm wide.

Spore print brownish. Spores 5.8–7.5 $\times$ 5–4 μ , smooth, intensively light refracting. Basidia 17–30 $\times$ 5.5–7.3 μ , with two or four spores and sterigmata 4–4.5 μ long. Crystals occur between the basidia. Cystidia none. Trame in water violet or lilaceous-brownish, in ammonia — gray-blue, in acid — lilaceous; tramal hyphae cylindrical, almost parallelly arranged; between them lactiferous hyphae.

Habitat. In coniferous forests on the ground and rotten trunks of *Pinus sylvestris*. In mountains it occurs up to 1200 m a.s.l. Fall.

Distribution. Hitherto, known from the environs of Voronezh and from the Caucasus (USSR).

Genus *Phylloporus* Quél.

Phylloporus Quél., Flore Mycol., p. 409, 1888.

Pileus dry, mat, delicately tomentose or pubescent. Stipe solid, cylindrical, rarely swollen, invariably with a pink or brick-red tint. Veil none. Hymenophore lamellate, decurrent. Lamellae mostly connected in places by veins, lower or higher ribs sometimes forming anastomosing irregular pores of various size. Spore print yellow. Spores intensively elongated.

Fungi belonging to this genus occur on ground, rarely on rotten trunks, almost on the entire globe, but most frequently observed in north-eastern Asia, Africa, North America and Europe. Hitherto, seven species are known, only one of them is found in Europe.

1. *Phylloporus rhodoxanthus* (Schw.) Bres.

Agaricus rhodoxanthus Schw., Schr. Naturf. Ges. Leipzig 1822, 1:83, 1822. — *Gomphidius rhodoxanthus* (Schw.) Sacc. Syll. 5:1139, 1889. — *Paxillus rhodoxanthus* (Schw.) Rick., Blätterp., 1:95, 1911. — *Phylloporus rhodoxanthus* (Schw.) Bres., Fungi Trid., 2:95, 1900.

Agaricus pelletieri Lév. in Crouan, Fl. Finistère, p. 81, 1867. — *Agaricus paradoxus* Kalchbr., Icon. Fung., p. 27, 1873. — *Paxillus pelletieri* (Lév. in Crouan) Velen., Česk. Houby, 2:356, 1920.

Pileus up to 8 cm in diameter, fleshy, convex, later flattened or even somewhat depressed in the center, delicately pubescent, velvety, mat, dry, with age becoming smooth, brown, brown-red, during drought lighter. Margin of the pileus initially involute, straightening during development. Stipe frequently excentric, up to 6×1.4 cm, cylindrical, at the base contracted, at the tip widened, solid, strong, ribbed upward owing to far-decurrent lamellae, yellow with a red coating. Veil none. Context relatively soft, thick, pale yellow, under the cuticle of the pileus and sometimes at the base of the stipe vinous-red flushed. Taste mild, smell none. Lamellae loose, large, up to 0.9 cm wide, thick, soft, waxy, uneven, connected with anastomoses, forming in some places small depressions and pores; readily separable from the pileus; golden-yellow, when touched sometimes reddish.

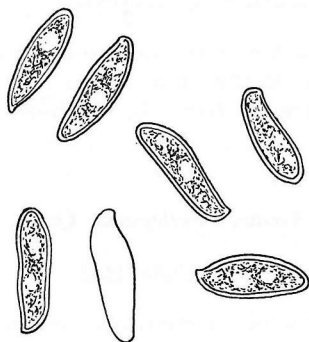


Fig. 49. Spores of *Phylloporus rhodoxanthus* (Schw.) Bres. (from the specimen collected by B. Gumińska at Rabsztyn on September 3, 1956); ($\times 1000$).

Spore print yellow-ochre to olive-ochre. Spores ellipsoidal-fusiform, with granular content, smooth, $10-14 \times 3.5-5 \mu$ (Fig. 49). Basidia $35-40 \times 8-10 \mu$. Cystidia cylindrical and fusiform, yellow, $60-80 \times 9-14 \mu$. Clamp connections not seen.

Habitat. It occurs singly or in small groups in mixed forests, on shaded road-sides. Very rare. August–September.

Distribution in Poland. In the 19th century it was recorded only five times. Its habitats are observed in Silesia (Grodziszczce and Kalwaria Mt. near Bardo, near Ząbkowice Śląskie, Lubsza near Brzeg, Paczków near Bystrzyca Kłodzka, Osie). Recently it has been observed at Rabsztyn near Olkusz and at Maciejowa near Łabowa. Further to the north, Gramberg (1923) observed it in the environ of Kalininograd (USSR). It should be further sought for.

General distribution. Europe, North America.

Notes. Edible. It is characterized by decurrent and anastomosing lamellae owing to which the hymenophore acquires a cellular appearance. This species constitutes a link connecting the families *Paxillaceae* and *Boletaceae*; it is most closely allied to the genus *Xerocomus*.—Konrad et Maublanc, pl. 392; Singer 1965, Taf. 11, 1–3.

FAMILY GOMPHIDIACEAE

Fungi of moderate size, with fleshy fruit bodies.

Pileus glutinous, viscid to mucilaginous, exceptionally dry (during fine weather), with an involute margin. Stipe central, cylindrical, solid. Veil universal, mostly well visible, more or less glutinous or mucilaginous, covering the stipe and pileus, at younger stages spreading between them in the form of arachnoid threads or mucilaginous membrane. Context relatively tough. Hymenophore lamellate. Lamellae thick, loose, decurrent, with bilateral frame; when ripe — dark brown to black.

Spore print black or olive-black. Spores large, fusiform, smooth, over 15 μ long. Cystidia large. Hyphae without clamp connections. Cuticle of the pileus consisting of cylindrical or spherical cells.

These fungi occur on ground, forming mycorrhiza with coniferous trees. Hitherto, 17 species have been described, all of which are edible.

KEY TO THE GENERA

- | | | |
|-----|---|-------------------------------|
| 1. | Cuticle of the pileus consisting of spherical cells | |
| | | <i>Cystogomphus</i> , p. 112. |
| 1*. | Cuticle of the pileus consisting of cylindrical cells | 2. |
| | | <i>Gomphidius</i> , p. 107. |

Genus *Gomphidius* Fr.

Gomphidius Fr. Epicr., p. 319, 1838.

Fleshy fungi with viscid to glutinous-mucilaginous, exceptionally dry (during long-lasting drought) pilei. Stipe cylindrical, dry or glutinous from remnants of the veil which is either arachnoid or membranous and glutinous. Context in the pileus white, pale pink or ochre. Taste mild, no specific smell. Lamellae decurrent, black to brown-black. Mycelium at the base of the stipe nonamyloid.

Spore print black. Spores large, over 15 μ long, fusiform. Cystidia large. Cuticle of the pileus without spherical cells.

Fungi belonging to this genus occur on ground in coniferous forests of the temperate zone of the North Hemisphere. In warmer zones they are observed in mountainous regions. They form mycorrhiza with various coniferous trees. Hitherto, 16 species are known, five of them occur in Europe. All the species are edible.

KEY TO THE SPECIES

1. Veil disappears very early leaving no traces. Species connected with the larch *G. maculatus*, p. 110.
- 1*. Veil or its traces invariably well visible 2.
2. Context in the pileus ochre 3.
- 2*. Context in the pileus white 4.
3. Pileus clay-brown, viscid. Stipe clay-yellow, somewhat viscid *G. rutilus*, p. 111.
- 3*. Pileus not so viscid, almost fibrillose stipe uniform, yellow to orange-ochre. Under the stone pine *G. helveticus*, p. 112.
4. Stipe at the base pink *G. roseus*, p. 109.
- 4*. Stipe at the base golden-yellow 4.
5. Pileus lilaceous-brown. Stipe without punctation, very glutinous. Veil or its traces well visible. Mainly under pines and spruces *G. glutinosus*, p. 108.
- 5*. Pileus flesh-brown, stipe with purple punctation, not glutinous. Traces of veil none. Context becoming pink. Under larches *G. maculatus*, f. *gracilis*, p. 111.

1. *Gomphidius glutinosus* (Schaeff. ex Fr.) Fr.

Agaricus glutinosus Schaeff. ex Fr., Syst. Mycol., 1:315, 1821. — *Gomphidius glutinosus* (Schaeff. ex Fr.) Fr. Epicr., p. 319, 1838.

Pileus fleshy, 5–12 cm in diameter, convex, with an involute margin, with age widely spread, sometimes with a small umbo in the center, but more frequently somewhat depressed; sordid purple, lilaceous-brown, chocolate-lilaceous, frequently with black stains, smooth, viscid or very glutinous, exceptionally dry during longer drought. Stipe 5–10×1–2 cm, generally of even thickness, solid, tough, at the apex whitish, at the base of vivid yellow, later rust color. Very glutinous, gelatinous owing to remnants of the annulus formed by the universal veil. Veil white with a lilaceous shade, membranaceous, mucilaginous, glutinous, disappearing. Context thick, soft, white, under the cuticle of the pileus brownish, in

the lower part of the stipe yellow. No specific taste nor smell. Lamellae decurrent, loose, forked, initially whitish, later gray to brown-black.

Spore print black. Spores under a microscope brown-olive, fusiform, containing several drops, $18-22 \times 5-8 \mu$ (Fig. 50). Cystidia cylindrical, $130-160 \times 12-16 \mu$. Cells of cuticle cylindrical.

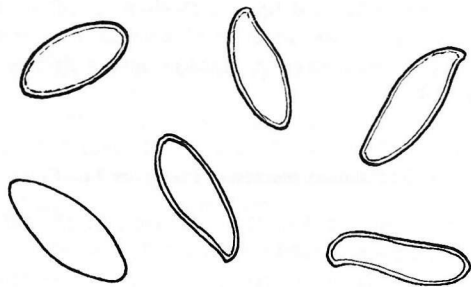


Fig. 50. Spores of *Gomphidius glutinosus* (Schaeff. ex Fr.) ($\times 1000$).

Habitat. Coniferous, spruce and pine (in Czechoslovakia mostly spruce) forests; on the ground. July–October.

Distribution in Poland. Common in the whole country.

General distribution. Holarctic species of the North Hemisphere.

Notes. Edible after removal of the gelatinous, very sour cuticle. Externally it resembles sometimes *Suillus luteus* (L. ex Fr.) S. F. Gray. It differs from *Gomphidius roseus* (Fr.) Fr. by the white tip of the stipe and white context. — Plates 29, 2; 30, 4. — Maublanc (1952), 154 II.

2. *Gomphidius roseus* (Fr.) Fr.

Agaricus (*Gomphus*) *lubricus* var. β *roseus* Fr. Syst. Mycol. 1:315, 1821. — *Agaricus glutinosus** *roseus* Fr., Epicr., p. 319, 1838. — *Gomphidius roseus* Gill., Champ. Fr., p. 623, 1878.

Pileus fleshy, initially convex, later flattened and depressed, 2–5 cm in diameter, flesh-pink, light red-pink, smooth, glutinous, (during long-lasting fine weather dry and shiny), with an involute margin. Stipe tough, contracted toward the base, $3-5 \times 1-1.5$ cm, glutinous, at the apex white, at the base pink. Veil arachnoid, somewhat glutinous, disappearing, leaving a thick annulus on the stipe. Context soft, white, under the cuticle and in the stipe — pink, with a mild, somewhat sourish taste and no smell. Lamellae decurrent, thick, loose, frequently forked, initially white, later gray, finally brown-olive.

Spore print black. Spores brown-olive, fusiform, smooth, containing several oleaginous drops, $15-20 \times 4-5.5 \mu$. Cystidia elongated, cylindrical, with irregular deposits of material, $120-160 \times 12-16 \mu$.

Habitat. Coniferous forests on sandy soil. In the Tatra Mts., at the margin of dwarf mountain pine clusters.

Distribution. In Czechoslovakia it occurs mainly in mountainous, spruce forests in moss. In Poland it has been recorded in the Tatra Mts. and in several low-land localities; Gdańsk, Olsztyn, Rawicz, Misie near Międzyrzecz, Sulistrowiczki near Wrocław, Goszczowice near Niemodlin, Człopa near Wałcz and the island Uznam.

General distribution. Europe, Asia.

Notes. Edible. It is characterized by the flesh-pink pileus and base of the stipe. This species is closely allied to *Gomphidius glutinosus* and sometimes was assumed as a variety of the latter. It is, however, smaller and exhibits a different color and longer spores. — Lange, 161 B.

3. *Gomphidius maculatus* (Scop. ex Fr.) Fr.

Agaricus maculatus Scop. ex Fr., Syst. Mycol., 1:315, 1821. — *Gomphidius maculatus* (Scop. ex Fr.) Fr., Epicr., p. 319, 1838.

Pileus fleshy, hemispherical, later flattened, 2–5 cm in diameter (Singer, 1938 — 11 cm), with an involute margin, white (Pilát, 1951) to flesh-ochre and brown flesh-colored, with numerous black-brown patches, dry, very glutinous during rain. Stipe generally cylindrical, slender, 10–15 × 1–1.5 cm, nonglutinous, initially white, later covered with droplets of a red-vinous, further blackening fluid; stipe with purple to purple-black flocci; at the base yellow, when touched blackening. Veil visible only at a very early stage of development; later disappearing without traces. Context soft, white, becoming pink by exposure, at the base yellow, with a mild, somewhat sourish taste and no smell (Singer: frequently distinct coumarin smell). Lamellae decurrent, not dense, thick, forked, with an obtuse edge; initially whitish, later gray, when touched becoming red and black.

Spore print black. Spores dark, sordid brown, fusiform, frequently with oleaginous drops, 16–20 × 5–8 μ . Cystidia numerous, large, 80–120 × 15–26 μ . Hyphae from the cuticle of the pileus incrustated, 4–14 μ in diameter.

Habitat. Submountainous forests, exclusively under larches, in summer; in the Tatra Mts. up to 1000 m a.s.l. (Pilát). July–September.

Distribution in Poland. Very rare. The Tatra Mts. It should be further sought for.

General distribution. Holarctic species.

Notes. Edible. It forms mycorrhiza with larches. In Czechoslovakia two forms of this species were observed. One, f. *Cookei* Masee (Cooke, III, t. 882, 1881–1891) characterized by a pileus of normal size, whitish, but with a gray-buff tint, with black-brown patches. It occurs in September, when the nights are cool. The second, f. *gracilis* Berk. et Br., (in Berk., Outl. Brit. Fung., p. 196, 1860) differing from typical specimens by smaller dimensions, 2–4 cm high and more slender shape (spores 15–18 × 5–8 μ); occurring mainly at the period of warm days of July and August.

The latter form *gracilis* was recorded in the Sudety Mts., in Silesia near Środa Śląska (September, October) by Schröter and in the pine forest on Kępa Redłowska near Orłowo (September) by Teodorowicz. Both these authors did not note whether larches grew in these forests. Besides, it was observed in Białowieża. Some mycologists treat the form *gracilis* as a separate species. The typical form, f. *maculatus*, relatively squat, with a flesh-ochre or brown-flesh-colored pileus and white context becoming pink, hitherto, was not found in Poland. — Lange, 161 C, f. *gracilis*; Ricken 3, Fig. 2.

4. *Gomphidius rutilus* (Schaeff. ex Fr.) Lundell et Nannfeldt

Agaricus rutilus Schaeff. ex Fr., Syst. Mycol., 1:315, 1821. — *Gomphidius rutilus* (Schaeff. ex Fr.) Lund. et Nannf. Fung. Exs. Suec., p. 409, 1937.

Gomphidius viscidus (L. ex) Fr., Epicr., p. 319, 1838. — *Chroogomphus rutilus* (Schaeff. ex Fr.) O. K. Miller, Mycologia, 54:543, 1964.

Pileus fleshy, convex-conical, later expanded, but generally with a more or less distinct umbo, with an involute margin, 4–8–(15) cm in diameter, purple-brown with a copper tint, clay-brown, smooth, glutinous, dry only during long-lasting drought. Stipe 5–8×1–2 cm, elongated, sometimes contracted toward the base, somewhat fibrillosely striated and but slightly viscid, yellow-buff, with age becoming brown, but invariably with a pink tint. Veil arachnoid, disappearing. Context thick, tough, yellow-ochre, buff, darker ochre at the base. Lamellae intensively decurrent, loose, thick, yellow-gray, gray-purple, finally brown-purple with a flocculent edge.

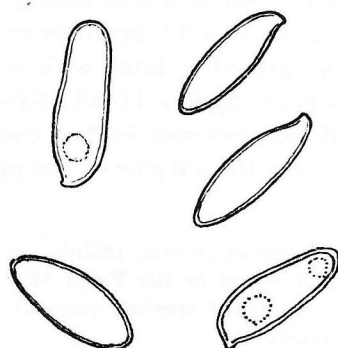


Fig. 51. Spores of *Chroogomphus rutilus* (Schaeff. ex Fr.) O. K. Miller (×1000).

Spore print olive-black. Spores smooth, sordid brown, fusiform, with several (frequently three) oleaginous droplets, 18–22×6–7 μ (Fig. 51). Cystidia cylindrical, 125–160×15–18 μ , mainly on the edge of lamellae.

Habitat. Coniferous forests. July–October.

Distribution in Poland. Relatively common in the whole country.

General distribution. Europe, North America, partly Asia and Africa.

Notes. Edible. Somewhat resembling *Gomphidius glutinosus*, but it differs from the latter in the first place by the sordid ochre color of the context and mostly dry stipe. The variety var. *tatrensis* Pilát is characterized by a floccose, dry, ochre-orange pileus. Its stipe is large, cylindrical, of the same color as the pileus; lamellae initially of the same color, later grayish. Pileus and stipe becoming intensively red by exposure. Microscopical features typical for the species. In the Tatra Mts. this variety has been found on a single site at 1150 m a.s.l.

In Poland (Dębek near Żarnowiec and Kępa Redłowska near Orłowo) Teodorowicz (1936) described the form f. *truncicolus* with a pileus 1.5–4 cm in diameter and stipe 4–10×0.4–1.2 cm, occurring exclusively on rotten spruce trunks. The form f. *testaceus* Fr. was not observed in Poland. It is small, with an almost white mycelium, copper to vinous-red pileus and stipe, slightly decurrent lamellae; it occurs in deciduous forests, mainly under oaks and beeches. Singer collected it under pines in European mixed beech forests. He supposes that Kavina described a different form under this name. — Plate 29, 3. — Maublanc 154, I.

5. *Gomphidius helveticus* (Sing.) Moser.

Gomphidius helveticus Sing., Schweiz. Zeitschr. Pilzk., 1950.

Chroogomphus helveticus (Sing.) Moser in Gams Krypt.-Fl. 2 b (2):51, 1967.

Pileus with a distinct tooth or without it, up to 7 cm in diameter, sordid orange-yellow, less frequently pinkish, during drought purple-reddish with a copper tint; on its surface more or less distinct fibrillose flocci. Stipe 7.5×3.5 cm of a uniform orange-ochre or yellow color; tomentum at the base cream-pink with an arachnoid veil of the same color, when dried becoming purple-red. Context orange-yellowish, ochre, when dried becoming purple-red; taste mild; smell none. Lamellae loose, decurrent, relatively thick, gray-greenish, later with a pink tint.

Spore print greenish-gray. Spores 17–23×6.8–8 μ . Basidia 30–68×10–14.5 μ . Cystidia thin-walled, widened in the center, 60–112×15.8–24 μ . Terminal cells of hyphae from the surface of the pileus cylindrical; hyphae amyloid.

Habitat. Mountainous coniferous forests, mainly under the stone pine. August.

Distribution in Poland. Observed in the Tatra Mts.

Notes. It is a recently described species, resembling *Gomphidius rutilus*; its distribution is not known precisely.

Genus *Cystogomphus* Singer

Cystogomphus Singer., Ann. Mycol., 4:51, 1942.

The features of the family appertain to this genus which is characterized by a veil consisting of spherocysts (spherical calls).

A single species the distribution of which is unknown, is described. Probably it forms mycorrhiza.

— *Cystogomphus humblotii* Sing.

Cystogomphus humblotii Sing., Ann. Mycol. 40:51, 1942.

Gomphidius tomentosus Humblot non Murill, Bull. Soc. Mycol. Fr. 42, 73, 1926.

Pileus 5–6 cm in diameter, initially spherical, later spread and depressed, with an involute margin, dry, cream-orange, covered with a granular, cinnabar-red veil forming setaceous flocci at the apex of the pileus. Stipe 5–6×0.6–0.8 cm, of a similar color, cinnabar, with a wide annulus. Context white, in the stipe red and at the base black-navy-blue. Lamellae initially reddish, later black with white edges.

Spore print black. Spores 18–21×6–7 μ , fusiform. Cystidia 100–150×18–20 μ .

Habitat. Under spruces.

Distribution. In Poland not observed. Hitherto, found only in the environs of Paris.

Notes. It differs from the representatives of the genus *Gomphidius* by the presence of spherical cells in the cuticle of the pileus.

FINAL NOTE

The following names of fungi collected in Poland by older authors belong to synonyms of species at present classified to quite different genera and families:

Boletus Boltoni Pers. = representative of *Agaricaceae*.

Paxillus giganteus (Sow.) Fr. = *Clitocybe geotropa* (Bull. ex Fr.) Quél.

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VOCABULARY

of the most important mycological terms the knowledge of which is indispensable for the studies of pileate fungi

adhering — touching but not adnate (e.g., fibrils or scales on the pileus)

adnate — widely joined and grown together with another organ

allantoid — cylindric and somewhat arched, with rounded ends

ample — of a wide spread volva

ampulliform — in the shape of a flask, widened at the base and elongated, contracted at the tip (of cystidia)

amyloid — (reaction) turning blue or livid when treated with iodine

anastomosis — short connection between two hyphae, ribs, folds, lamellae. A large number of anastomoses can form a kind of network

annulus — ring developed from remnants of the veil, sometimes rudimentary

apex — top (of the pileus)

apiculate — covered with sharp processes (comp. bristly)

apiculus — sharp projection at the base of the spore

arachnoid — consisting of delicate or parallel, entangled hair or fibers

arched — more or less delicately curved on one side

areolate — cracked into small patches

basidiole — sterile cell occurring between the basidia, generally these are young basidia which do not develop sterigmata

basidium — characteristic element of the hymenium producing spores (mostly four)

beaded — covered with grains arranged in lines in several strands (of spores)

bilateral — having two sides (of the kind of trame in lamellae)

bilateral reversed — having two sides but situated in the inverse direction than bilateral (of the kind of trame in the lamellae)

bisterigmate — having two sterigmata (of basidia)

blanching — short boiling or straining of fruit bodies

bulb — spherical swelling of the base of the stipe resembling a tuber of floristic plants (e.g., in *Amanita muscaria*)

bundle — of fruit bodies growing from one site, the stipes of them are more or less parallel to each other

bysoid — resembling cotton wool, of a fluffy tangle of delicate and silky fibrils or threads (e.g., at the base of the stipe)

capitate — with a spherical, rounded swelling at the tip

canaliculate — of stipe hollow inside but with a very small lumen

caulocystidia — cystidia developing on the stipe

cellular — of the structure of any part of the fruit body consisting of isometric or somewhat elongated cells

chambered — having numerous, irregular chambers (e.g., stipe in the representatives of the genus *Gyroporus*)

cheilocystidium — cystidium developing on the edge of lamella or pore

ciliate — with a long hair on the margin

cilium — hairlike outgrowth

clamp connection — small unilateral thickening of the hypha near a septum, remnant of the division of cell
 clavate — long, gradually widening toward the tip and obtuse at the end
 cluster — system of fruit bodies growing from one point with stipe arch-like curved from the main axis of the cluster (e.g. in *Pholiota*)
 context — flesh; sterile mass of fruit body of pileate fungi
 coprophilous — growing on excrements
 coriaceous — having the consistency of leather, i.e., rather flexible, hard
 cortina — a partial veil in the form of threads
 crested — having a relief in the form of low comb (of spores)
 curled — twisted in various directions
 cuticle — thin layer of hyphae covering the pileus
 — cellular — consisting of spherical cells
 — filiform — consisting of elongated cells parallel to the surface
 — brushlike — consisting of elongated cells protruding upward
 cystidiolate — a sterile hymenial cell protruding a little beyond the hymenial surface
 cystidium — a sterile cell occurring in hymenium, generally larger than the latter and of different shape
 deliquescent — with age liquefying (of lamellae of *Coprinus*)
 dendroid — treelike in form
 disk — central part of the pileus lying directly above the stipe
 dichotomic — two-forked
 discoid — circular, flat-convex, or bilaterally convex
 dispersed — growing singly but several individuals are not far from one another
 edge — sharp, free margin of lamellae
 ellipsoidal — having the shape obtained by rotation of an ellipse around a single axis (of spores)
 elliptic — having an outline in the shape of ellipse, i.e., having two axes

of symmetry (of spores in optical cross section)
 epigeic — occurring on the ground surface (of fruit bodies)
 extracellular — occurring beyond cells (of pigments)
 farinuous — mealy, like meal in form or smell
 felty — having a surface of irregularly and densely tangled hyphae (of the pileus)
 fibrillose — consisting of hyphae parallel to one another
 filiform — (1) resembling a thread (of the stipe), (2) of the structure of the trame with thin, parallelly arranged long cells
 fimbriate — (1) of an organ in the form of drooping, narrow lobes, (2) of the margin of the pileus from which fringes of the veil droop
 flabelliform — having a shape of a spread fan
 fleshy — (1) rather succulent and soft, readily perishable, (2) pileus with a thick context
 flexible — deflecting (under pressure) and regaining its former shape
 flexuose — somewhat undulated
 flocci — fascicles of hyphae having the appearance of elongated small squames
 forked — having two or more ramifications
 free — not adnate (of lamellae)
 fruit body — formation consisting of mycelium on which or in which hymenophore develops
 gasteromycetoid — resembling *Gasteromycetes*
 germ-tube — hypha with which the spore "germinates"
 granular — (1) covered with very small particles (of the membrane of spores), (2) of the content of cells with numerous droplets
 groups — occurring in large numbers near to each other but growing singly
 guttate — having tearlike drops

habit — general, external appearance
 habitat — site of occurrence of the fungus under normal conditions
 hilum — trace on the spore left after detachment from the sterigma
 hyaline — colorless, somewhat transparent
 hygrophanous — having a water-soaked appearance when wet
 hygroscopic — becoming soft in wet air
 hymenium — in *Basidiomycetes*, a layer of hyphae consisting of parallelly arranged basidia and sterile cells
 hymenophore — part of the fruit body (lamellae, tubes) on which the hymenium develops
 hypha — filiform fragment of the mycelium
 hypogeic — occurring in the ground, subterranean (of fruit bodies)
 incrustated — covered with a matter excreted on the wall (of cystidia of *Inocybe*)
 incurved — having a margin curved downward in respect to the pileus
 infundibuliform — of a pileus resembling a funnel
 involute — of a margin of a pileus deflected downward and forming a roll
 joint — of two organs connected with each other if no differential layer occurs between them (of the pileus and stipe)
 labyrinthine — very intensively curved, forming pores and irregularly intersecting canals
 lacerate — with the edge of lamellae irregularly torn
 lamella — gill; thin leaflike formation generally on the lower side of the pileus constituting a part of the hymenophore
 lamellate — hymenophore consisting of lamellae
 lanceolate — long, rounded and wide at the base, pointed at the tip (of cystidia)

lateral — of a stipe occurring on one side of the pileus
 laticiferous hyphae — sap hyphae; long hyphae of the context containing sap ("milk")
 ligneous — hard as wood
 locality — site on which the specimen was found
 macroscopic — perceivable with the naked eye
 merulioid — resembling the hymenophore of *Merulius*
 mobile — of the annulus, not adnate to the stipe (e.g. in *Lepiota procera*)
 motley — with lamellae on which agglomerations of ripe and unripe spores form darker and lighter spots
 mottled — exhibiting numerous, irregularly arranged light strands on a dark background
 mucilaginous — sticky when wet, slimy
 mycelium — the thallus of the fungus
 mycorrhiza — association of fungi and roots of plants
 nodular — with at least several eminences (of spores of *Inocybe*)
 ombrophilous — preferring shaded sites
 optical cross section — used for the determination of the outline of an organ along its longest axis, observed under a microscope (mainly of spores)
 ornamentation — relief (of spores)
 patches — remnants of the universal veil occurring on the pileus
 pergameneous — thin, dry, resembling paper
 pileus — part of the fruit body on which the hymenophore develops
 pilocystidia — cystidia occurring on the cuticle of the pileus
 pilose — covered with long, dense, soft and irregularly arranged hair
 pithy — with age or owing to water deficiency acquiring a cottony consistency inside (of the stipe)
 plage — small and smooth area on the ventral side of a spore in the environ of hilum

pleurocystidia — cystidia occurring on the surface of lamellae or within tubes

pore — small opening, (1) outlet of tubes in *Boletaceae* and *Polyporaceae* (when the color is given, e.g., "pores red" it indicates the color of hyphae lining the opening), (2) place at the tip of some spores where a certain differentiation occurs in the thickness of the wall in the form of a roundish spot (germ spore) where the germ follows

posterior — denoting the part of lamella situated near the stipe

protruding — longer than the adjacent organ

pseudorrhiza — a rooting base of the stipe (e.g., in *Mucidula radicata*)

regular — this term concerning the trame determines a parallel arrangement of hyphae

reticulate — resembling a net, netted (of the relief of the stipe or spores)

revolute — having the edge rolled back or up (of the pileus)

rhizomorph — cordlike structure made of hyphae (occurring in the soil or any substrate)

rib — longitudinal, distinct thickening exhibiting edges

ribbed — provided with ribs (e.g., of the pileus)

robust — thick and not hollow

rootlike — having a pseudorrhiza

rugose — having numerous, minute, shallow and irregular folds

sap — (milk) generally colored and nontranslucent liquid flowing from bruised fruit bodies

scales — squama; agglomeration of hyphae, wide at one end and greatly contracted at another thus acquiring the shape of the triangle

sclerotium — a kind of resting form; a compact mass of hyphae from which fruit bodies of some fungal species grow (*Collybia tuberosa*)

septate — with a detachment wall

septum — detachment wall separating two cells in hypha

serrate — resembling the edge of a saw (of the edge of lamellae)

sessile — having no stipe

seta — small, thin and long hair

setaceous — covered with bristles

solid — not hollow

spatulate — widened and flattened at the tip

spine of lamella — the margin of the lamella opposite the edge

spongy — (1) of a soft, rather flexible and porous organ, (2) resembling the consistency of cotton wool or a sponge (of the context in the stipe of *Gyroporus castaneus*)

spore — cell serving for reproduction of certain plants, also fungi

spore print — spores which after being shed from the hymenophore form a layer of "powder"

sporulation — production of spores

spur — lateral, contracted process (of spores of some *Lepiota*)

squamose — scaly; covered with squamae

sterigma — thin and small process on the basidium on which the spore develops

stinging — causing a feeling of strong burning in the mouth similar to that after munching pepper

stipe — part of the fruit body, stem

stria — a line; narrow, long traces of a different color than the background, generally occurring on the pileus

striate — marked with numerous, darker, less frequently lighter, lines

suberose — having a consistency of a cork

torquate — of the annulus drooping in the form of a collar

tough — relatively hard context not deflecting when touched

trame — layer of hyphae in the central part of the gill, a spine or dissepiment between pores

tubercle — very small wartlike process

tubes — components of the hymenophore of *Boletaceae* and *Polyporaceae*

tubular — (1) having the shape of a tube; of the stipe with a relatively large lumen (about 1/2 of the diameter), (2) of the hymenophore consisting of a number of tubes

umbo — a central swelling, like a boss on the top of the pileus

undulate — having a surface curved

veil — layer of tissue having the form of membrane (or cortina) covering the fruit body while development takes place (universal veil)

velvety — or velutinous, of the pileus (with a slight gloss) the cuticle of which consists of hyphae with terminals arranged perpendicularly to

the surface and forming a dense, even layer

ventral — of the side of any organ; in spores the side directed toward the axis of basidium

vesicular — wide oval, resembling a bladder (of cystidia)

villose — covered with long hair of various length (comp. tomentose)

volva — a cuplike sheath at the base of the stipe developed from a universal veil after its disruption (when the veil is membranous or imperishable)

waxy — having lamellae giving an impression as if covered with greasy substance

winged — provided with wings or a narrow ledge (of spores)

wiry — stiff, thin and long, resembling a piece of wire (of the stipe)

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PLATES

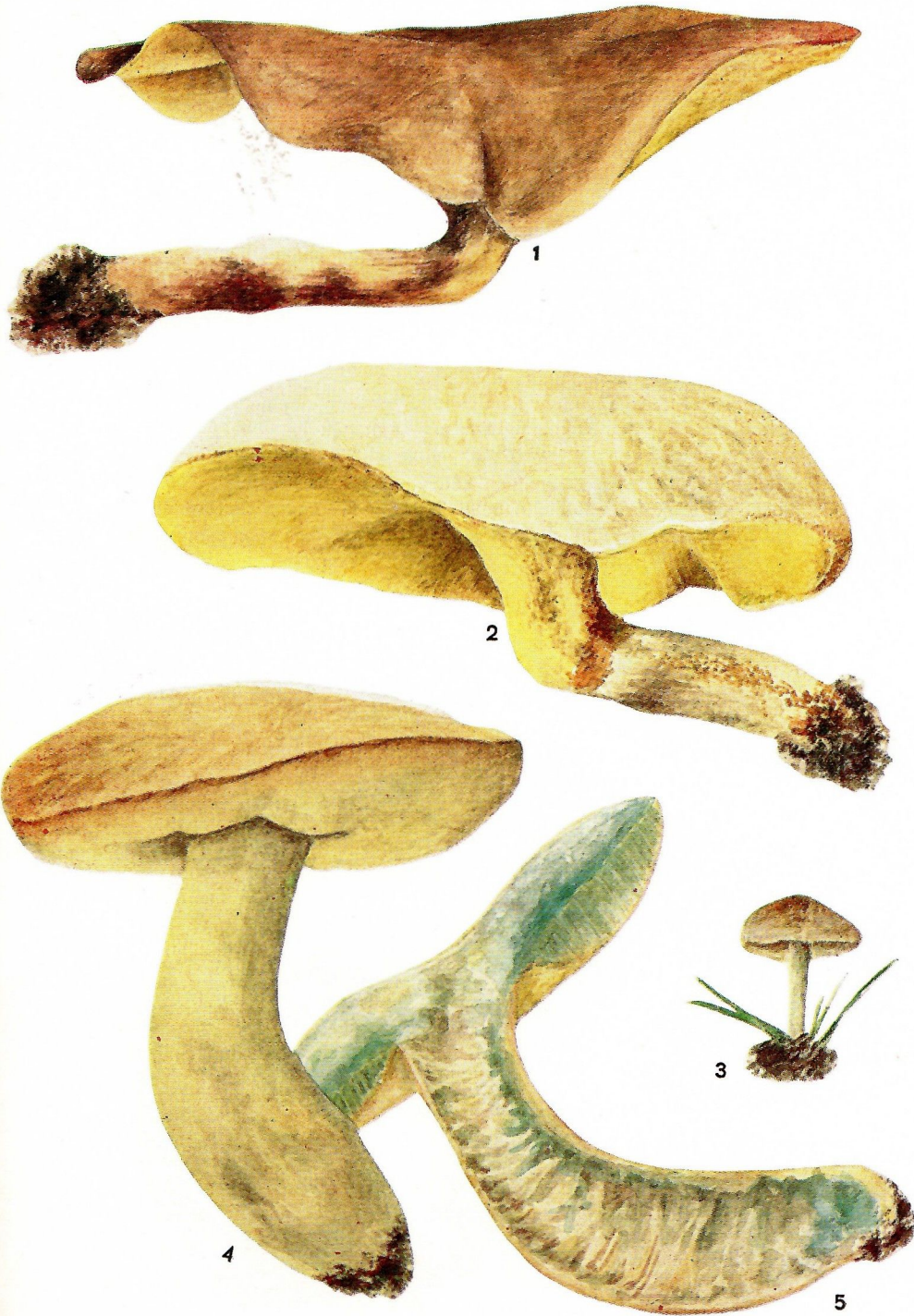
Plate 1

Gyrodon lividus (Fr.) Sacc.

1, 2 — Ripe fungi. Environs of Kuźnica Białostocka, August 1938. 3 — Young fungus. Environs of Kuźnica Białostocka, August 1938.

Gyroporus cyanescens (Fr.) Quél.

4 — Ripe specimen. Mienia, September 25, 1935. 5 — Cross section of specimen in item 4.

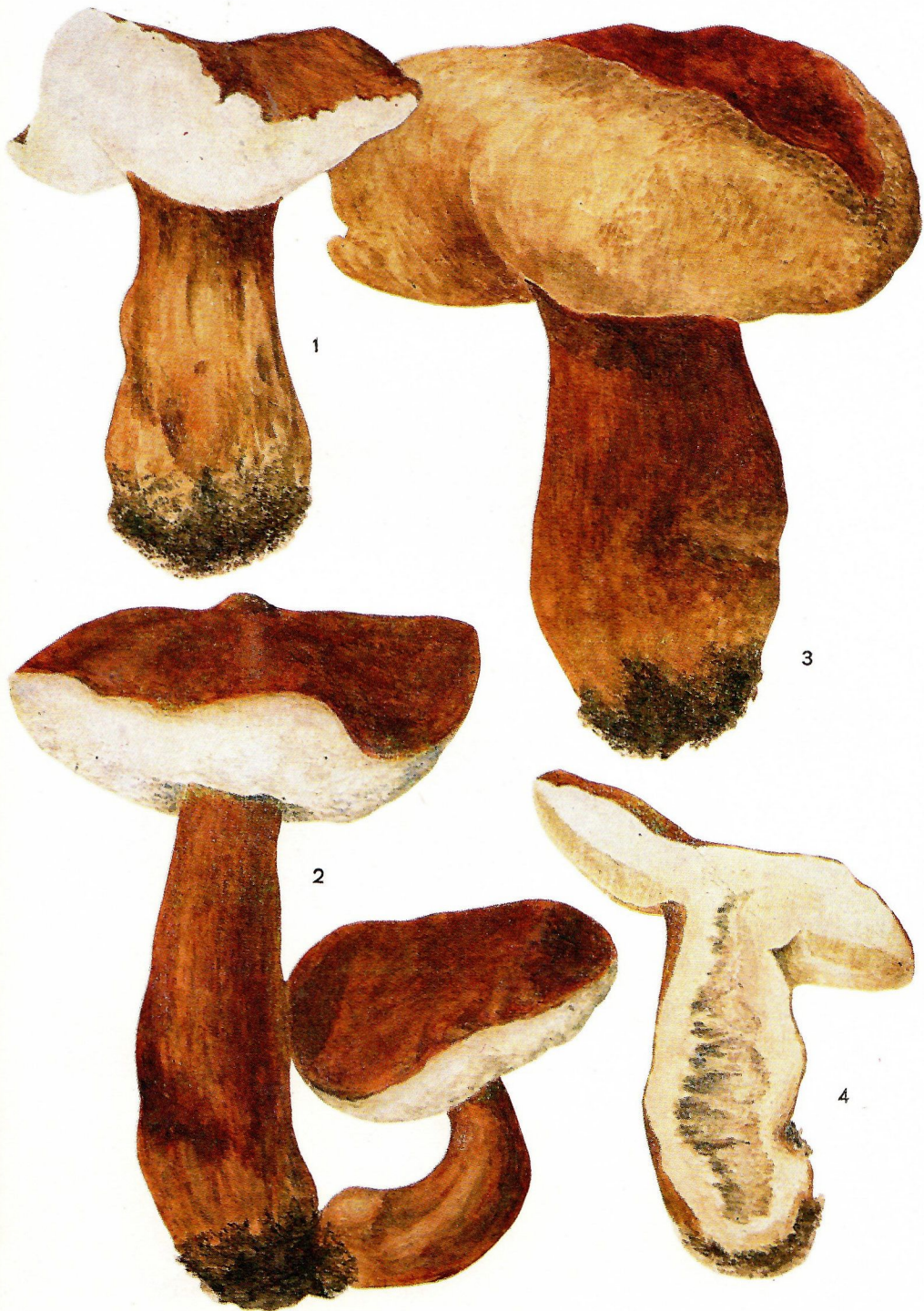


1-3 — *Gyrodon lividus* (Fr.) Sacc. 4-5 — *Gyroporus cyanescens* (Fr.) Quél.

Plate 2

Gyroporus castaneus (Fr.) Quél.

1 — Young fungus. Złoty Potok, August 23, 1936. 2 — Young fungi, Wawer, September 9, 1937. 3 — Ripe fungus. Environs of Kuźnica Białostocka, August 7, 1934. 4 — Cross section of young fungus. Wawer, September 9, 1937.



Gyroporus castaneus (Fr.) Quél.

Plate 3

Suillus flavidus (Fr.) Sing.

1 — Ripe specimen (after Kallenbach, T. 50, Fig. 16).

Boletinus cavipes (Opat.) Kalchbr.

2 — Young fungus. Złoty Potok, August 22, 1936. 3 — Cross section of young specimen. Złoty Potok, August 23, 1936. 4 — Ripe fungus. Złoty Potok, August 22, 1936.

Suillus placidus (Bon.) Sing.

5 — Ripe specimen (after Kallenbach, T. 37, Fig. 12).

Suillus aeruginascens (Secr.) Snell

6-7 — Ripe specimen and its cross section. Modrzewina near Mała Wieś, September 7, 1937. 8 — Ripe specimen. Modrzewina near Mała Wieś, September 7, 1937.



1 — *Suillus flavidus* (Fr.) Sing. 2-4 — *Boletinus cavipes* (Opat.) Kalchbr. 5 — *Suillus placidus* (Bon.) Sing. 6-8 — *Suillus aeruginascens* (Secr.) Snell.

Plate 4

Suillus grevillei (Klotzsch) Sing.

- 1 — Ripe fungus. Mała Wieś near Grójec, July 21, 1955. 2 — Young fungus. Environs of Kuźnica Białostocka, July 22, 1934. 3. — Cross section of ripe fungus. Environs of Kuźnica Białostocka, July 20, 1934. 4 — Cross section of young fungus. Environs of Kuźnica Białostocka, July 26, 1934. 5 — Young fungus. Krościenko on the Dunajec River, September 22, 1955. 6-8 — Young fungus. Mała Wieś near Grójec, July 21, 1955. 9 — Group of young fungi. Ruciane, July 22, 1954.



Suillus grevillei (Klotzsch) Sing.

Plate 5

Suillus bovinus (Fr.) O. Kuntze

1, 3 — Young specimen and its cross section. Czarna Struga, September 5, 1937. 2 — Ripe specimen. Kuźnica Białostocka, August 21, 1936. 4 — Ripe specimen. Modrzewina, September 7, 1937.

Suillus luteus (Fr.) S. F. Gray

5, 8, 9 — Ripening fungi. Rybienko, July 22, 1937. 6 — Very young fungus. Kuźnica Białostocka, August 13, 1935. 7 — Ripe specimen. Lubniewice, August 18, 1954.



1-4 — *Suillus bovinus* (Fr.) O. Kuntze. 5-9 — *Suillus luteus* (Fr.) S. F. Gray.

Plate 6

Suillus granulatus (Fr.) O. Kuntze

1-2 — Young fungus and its cross section. Chojnów near Piaseczno, June 25, 1934. 3 — Ripe fungus. Kuźnica Białostocka, July 25, 1935. 4 — Young fungus. Sosnowe, July 13, 1937. 5 — Ripe fungus. Chojnów, June 25, 1934. 6 — Young fungus. Environs of Kuźnica Białostocka, August 28, 1934. 7 — Cross section of ripe fungus. Environs of Kuźnica Białostocka, July 25, 1935. 8 — Young fungi. Chojnów, June 18, 1934. 9-10 — Young fungi. Environs of Kuźnica Białostocka, July 19 and 28, 1934. 11 — Old fungus. Environs of Kuźnica Białostocka, July 28, 1934. 12-14 — Young fungi. Ruciane, August 2, 1947.



Suillus granulatus (Fr.) O. Kuntze.

Plate 7

Suillus piperatus (Fr.) O. Kuntze

1—Ripe fungus. Czarna Struga, September 12, 1957. 2—Young specimen. Chojnów, August 22, 1950. 3–4—Young fungus and its cross section. Kuźnica Białostocka, August 3, 1934. 5—Ripe specimen. Czarna Struga, September 5, 1937.

Suillus variegatus (Fr.) O. Kuntze

6–7—Ripe fungus and its cross section. Szeroki Bór, August 17, 1955. 8—Very young fungus. Kuźnica Białostocka, July 31, 1935. 9—Old fungus. Czarna Struga, September 5, 1937.

Xerocomus parasiticus (Fr.) Quél.

10 — Young and ripe specimens. Stegna near Gdańsk, September 1, 1957.



1-5 — *Suillus piperatus* (Fr.) O. Kuntze. 6-9 — *Suillus variegatus* (Fr.) O. Kuntze.
10 — *Xerocomus parasiticus* (Fr.) Quél.

Plate 8

Xerocomus subtomentosus (Fr.) Quél.

1 — Old fungus. Modrzewina, September 7, 1937.

Xerocomus badius (Fr.) Kühn. ex Gilb.

2-3 — Ripe specimen and its cross section. Kamień near Ukta, August 15, 1957. 4 — Young fungus. Kuźnica Białostocka, September 10, 1954.

Pulveroboletus cramesinus (Sacc.) Moser

5-6 — Young specimen. Kuźnica Białostocka, August 14, 1936.

Pulveroboletus hemichrysus (Berk. et Curt.) Sing.

7 — Ripe fungus from the environ of Kaliningrad (after Kallenbach, T. 25, Fig. 17).

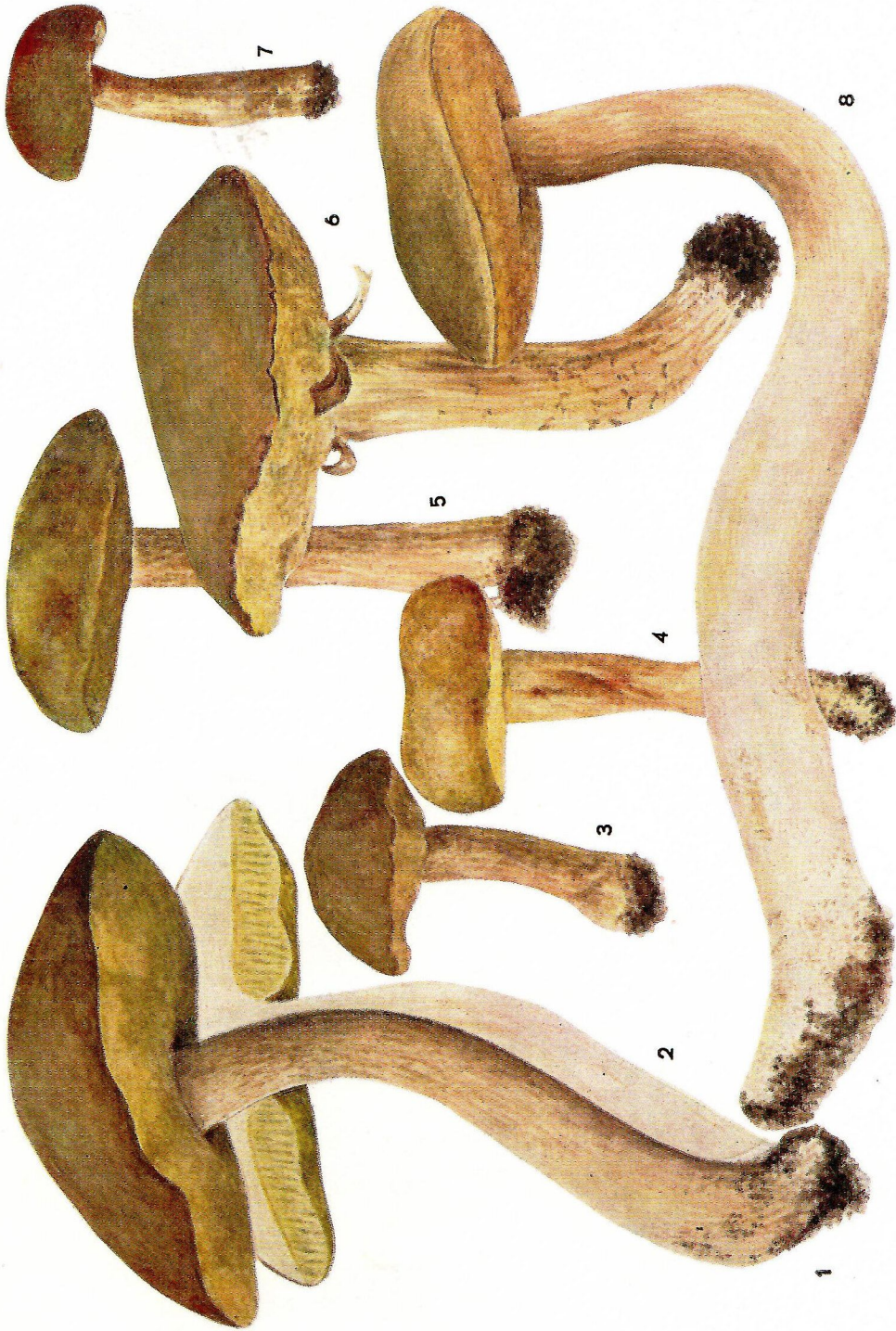


1 — *Xerocomus subtomentosus* (Fr.) Quél. 2-4 — *Xerocomus badius* (Fr.) Kühn. ex Gilb. 5-6 — *Pulveroboletus cramesinus* (Secr.) Moser. 7 — *Pulveroboletus hemichrysus* (Berk. et Curt.) Sing.

Plate 9

Xerocomus subtomentosus (Fr.) Quél.

1-2 — Ripe fungus and its cross section. Sosnowe, July 13, 1937. 3-7 — Specimens of various age. Ruciane, September 3-12, 1954. 8 — Ripe fungus developed under a root. Kuźnica Białostocka, September 6, 1934.



Xerocomus subtomentosus (Fr.) Quél.

Plate 10

Xerocomus chrysenteron (St.-Amans) Quél.

- 1 — Ripe fungus. Kuźnica Białostocka, September 3, 1934.
2 — Young specimen. Kuźnica Białostocka, September 3, 1934. 3-4 — Ripe specimen and its cross section. Ruciane, September 7, 1954. 5 — Young specimen. Ruciane, September 7, 1954.

Boletus rubellus Krombh. var. *armeniacus* (Quél.) comb. n.

- 6 — Ripe fungus. Kuźnica Białostocka, September 3, 1934.
7-8 — Ripe fungus and its cross section. Kuźnica Białostocka, August 2, 1934.



1-5 — *Xerocomus chrysenteron* (St.-Amans) Quél. 6-8 — *Boletus rubellus* Krombh.
var. *armeniacus* (Quél.) comb. n.

Plate 11

Boletus impolitus Fr.

1 — Ripe fruit body. Wisła, July 12, 1939.

Boletus pulverulentus Opat.

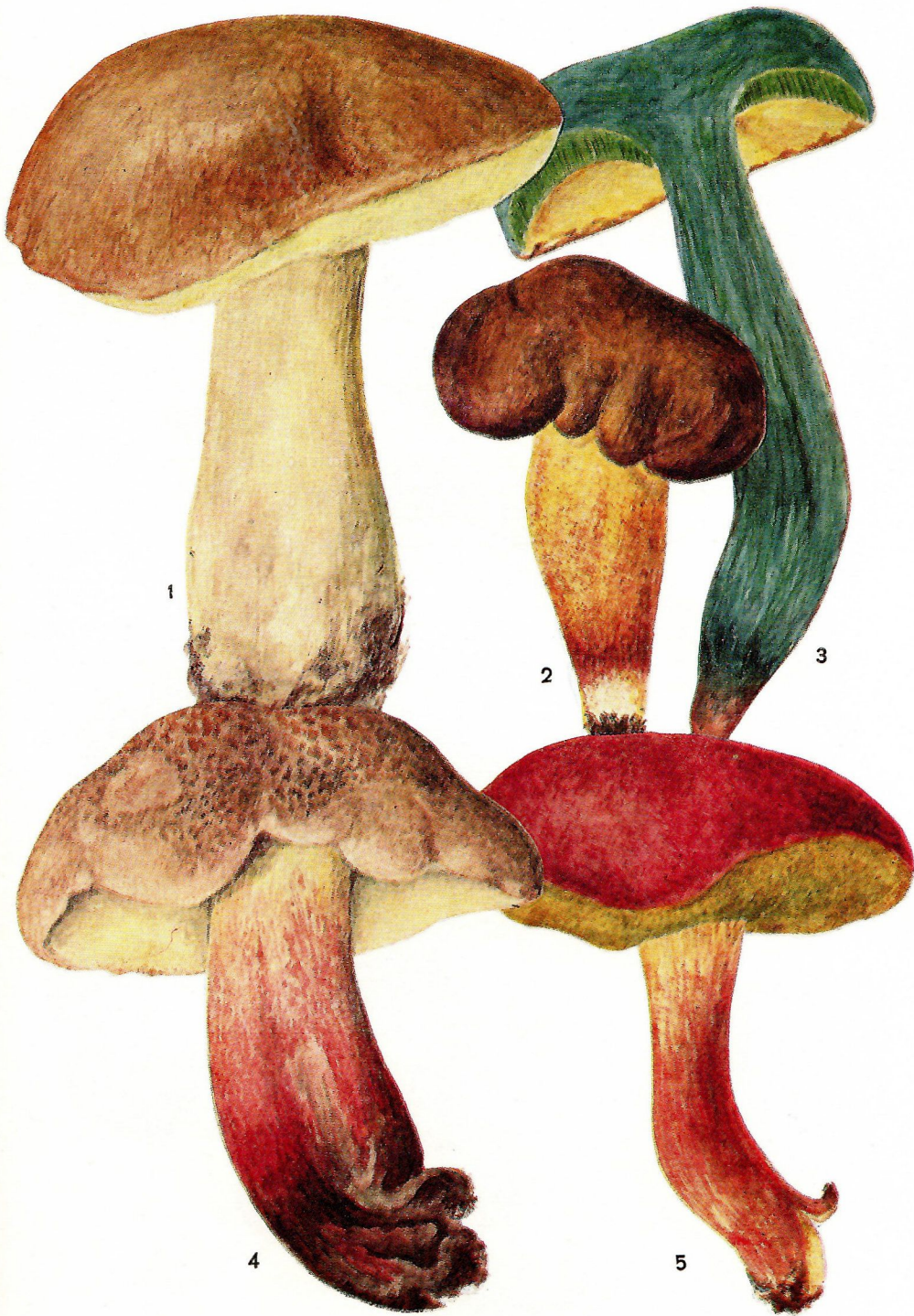
2-3 — Young fruit body and its cross section, Darmstadt
(after Kallenbach, Table 6, Figs. 4 and 13).

Boletus calopus Fr.

4 — Ripe fruit body. Wisła, July 12, 1939.

Boletus rubellus Krombh.

5 — Ripe fruit body. Wrzeszcz, September 2, 1957.



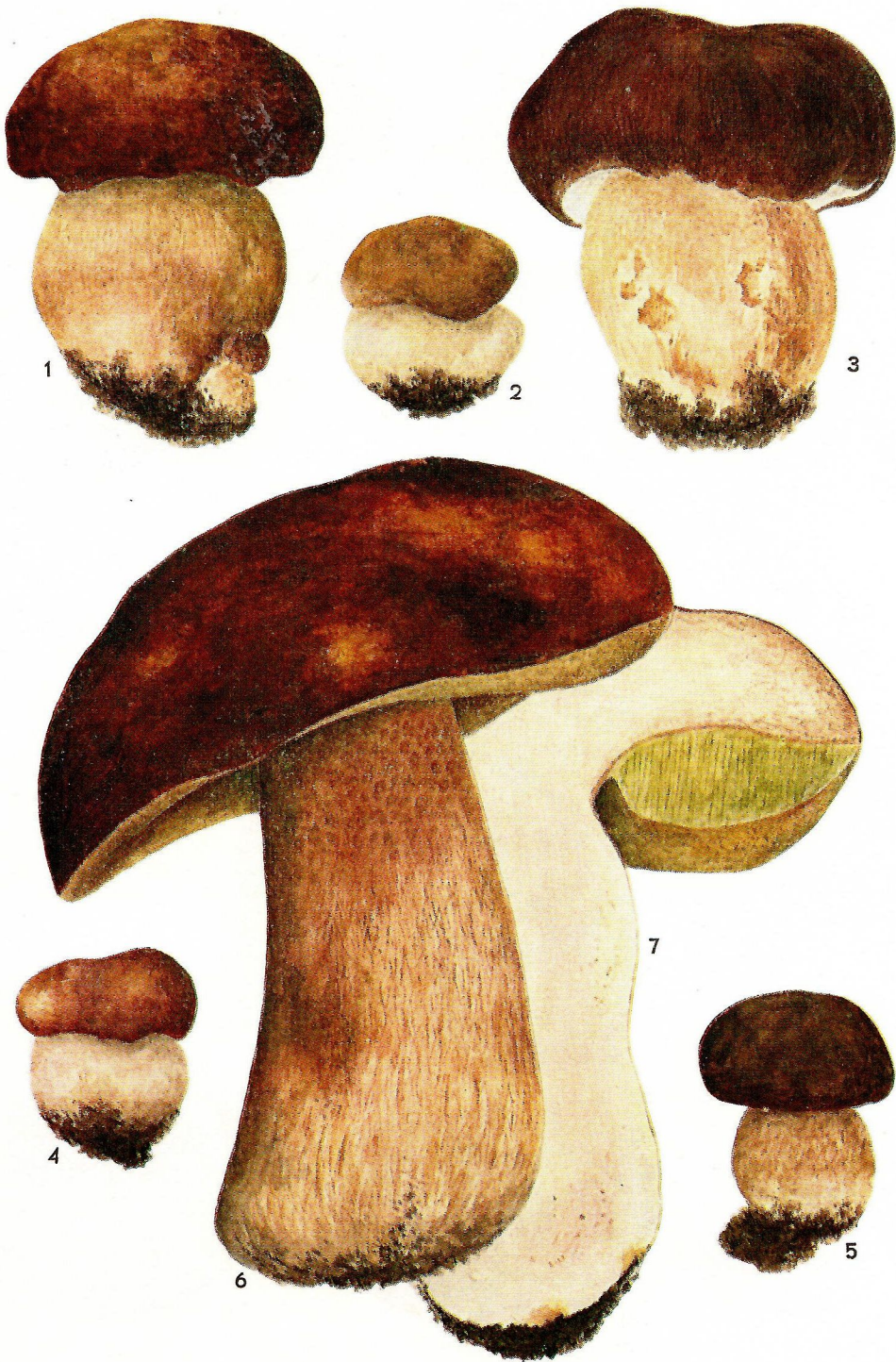
1 — *Boletus impolitus* Fr. 2-3 — *Boletus pulverulentus* Opat. (after Kallenbach)
4 — *Boletus calopus* Fr. 5 — *Boletus rubellus* Krombh.

Plate 12

Boletus edulis Fr. var. *pinicola* (Vitt.) Konrad et Maubl.

1-5 — Young specimens. Todorkowce near Grodno (USSR),
August 14-27, 1934.

6-7 — Ripe specimen and its cross section, Kuźnica Biało-
stocka, July 27, 1934.

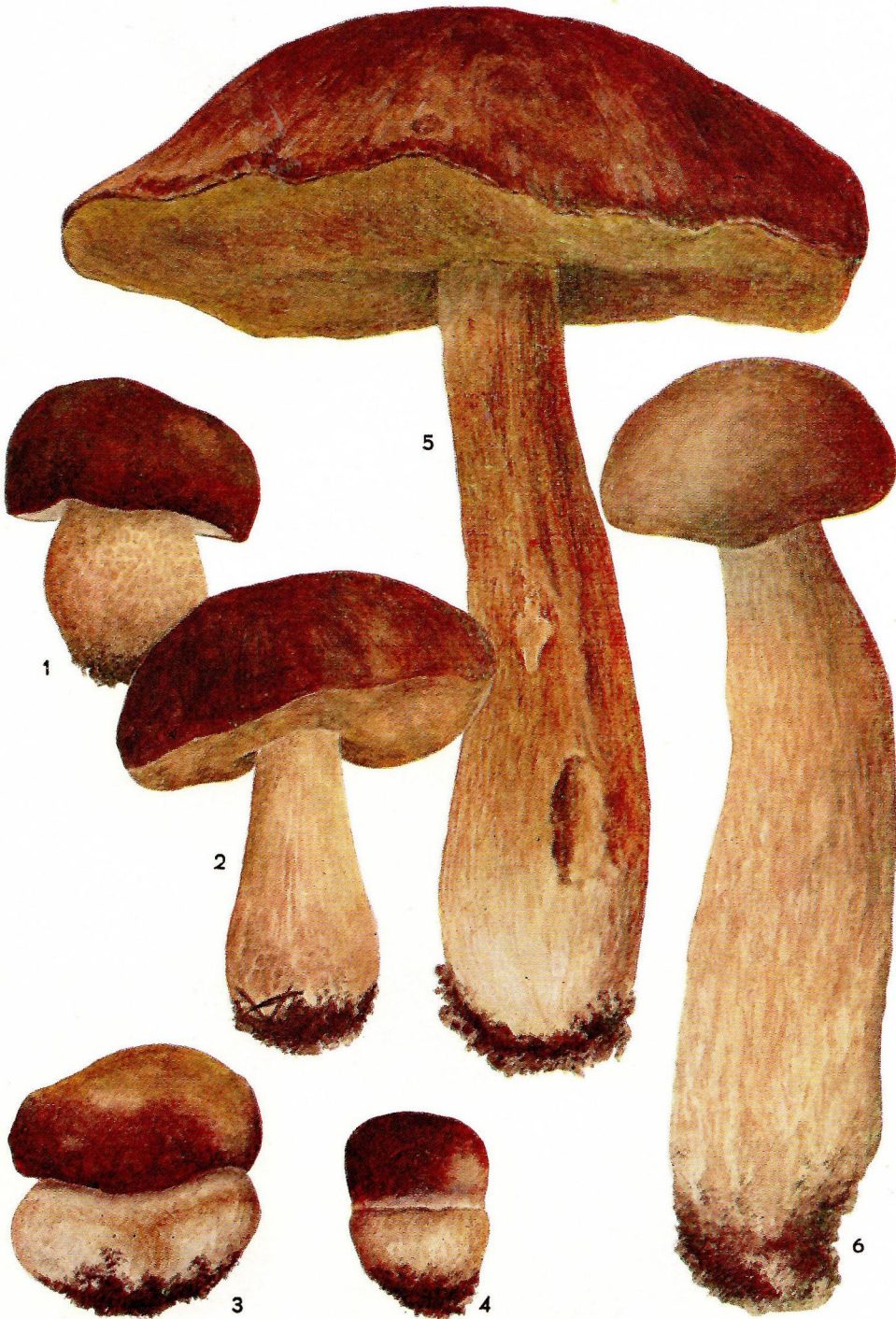


Boletus edulis Fr. var. *pinicola* (Vitt.) Konrad et Maubl.

Plate 13

Boletus edulis Fr. var. *pinicola* (Vitt.) Konrad et Maubl.
1-4 — Young specimens. Kuźnica Białostocka, August 14,
1934. 5 — Ripe specimen. Kredowe Góry near Grodno
(USSR), August 28, 1935.

Boletus edulis Fr. var. *edulis*
6 — Young specimen. Todorkowce near Grodno, August 19,
1934.



1-5 — *Boletus edulis* Fr. var. *pinicola* (Vitt.) Konrad et Maubl. 6 — *Boletus edulis* Fr. var. *edulis*.

Plate 14

Boletus edulis Fr. var. *edulis*

1-2 — Young specimens. Rybienko, August 22, 1950. 3 —
Young specimen. Leba, August 29, 1955. 4 — Ripe specimen.
Ruciane, September 12, 1954.



Boletus edulis Fr. var. *edulis*.

Plate 15

Boletus edulis Fr. var. *reticulatus* (Boud.) Bat.

- 1 — Ripe fungus. Kuźnica Białostocka, August 15, 1934.
2 — Unripe fungus. Białowieża, August 28, 1948.

Boletus edulis var. *edulis*

- 3 — Ripe fungus. Todorkowce (USSR), August 7, 1934. 4 —
Young specimen still concealed under the ground. Todor-
kowce (USSR), forest Szopenka, July 27, 1934. 5 — Young
fungus. Ruciane, August 17, 1955.



1-2 — *Boletus edulis* Fr. var. *reticulatus* (Boud.) Bat. 3-5 — *Boletus edulis* Fr. var. *edulis*.

Plate 16

Boletus edulis Fr. var. *edulis*

- 1 — Ripe fungus. Rybienko, August 19, 1950. 2 — Young fungus. Lubniewice, August 11, 1954.

Boletus edulis Fr. var. *betulicola* Vassilkov

- 3-4 — Young specimen and its cross section. Chojnów, near Piaseczno, May 10, 1934, leg. T. Pacyna.

Boletus edulis var. *aereus* (Bull. et Fr.) comb. n.

- 5 — Ripe specimen. Łomna near Jabłonków (Czechoslovakia), August 14, 1939.



1-2 — *Boletus edulis* Fr. var. *edulis*. 3-4 — *Boletus edulis* Fr. var. *betulicola* Vassil-
kov. 5 — *Boletus edulis* Fr. var., *aereus* (Bull. et Fr.) comb. n.

Plate 17

Boletus luridus Fr.

1-2 — Young specimen and its cross section. Struga near Tęgoborze, August 19, 1937. 3 — Ripe specimen. Struga near Tęgoborze, August 19, 1937. 4 — Very young specimen. Tęgoborze, August 22, 1937. 5 — Old fruit body. Todorkowce (USSR), July 15, 1935.



Boletus luridus Fr.

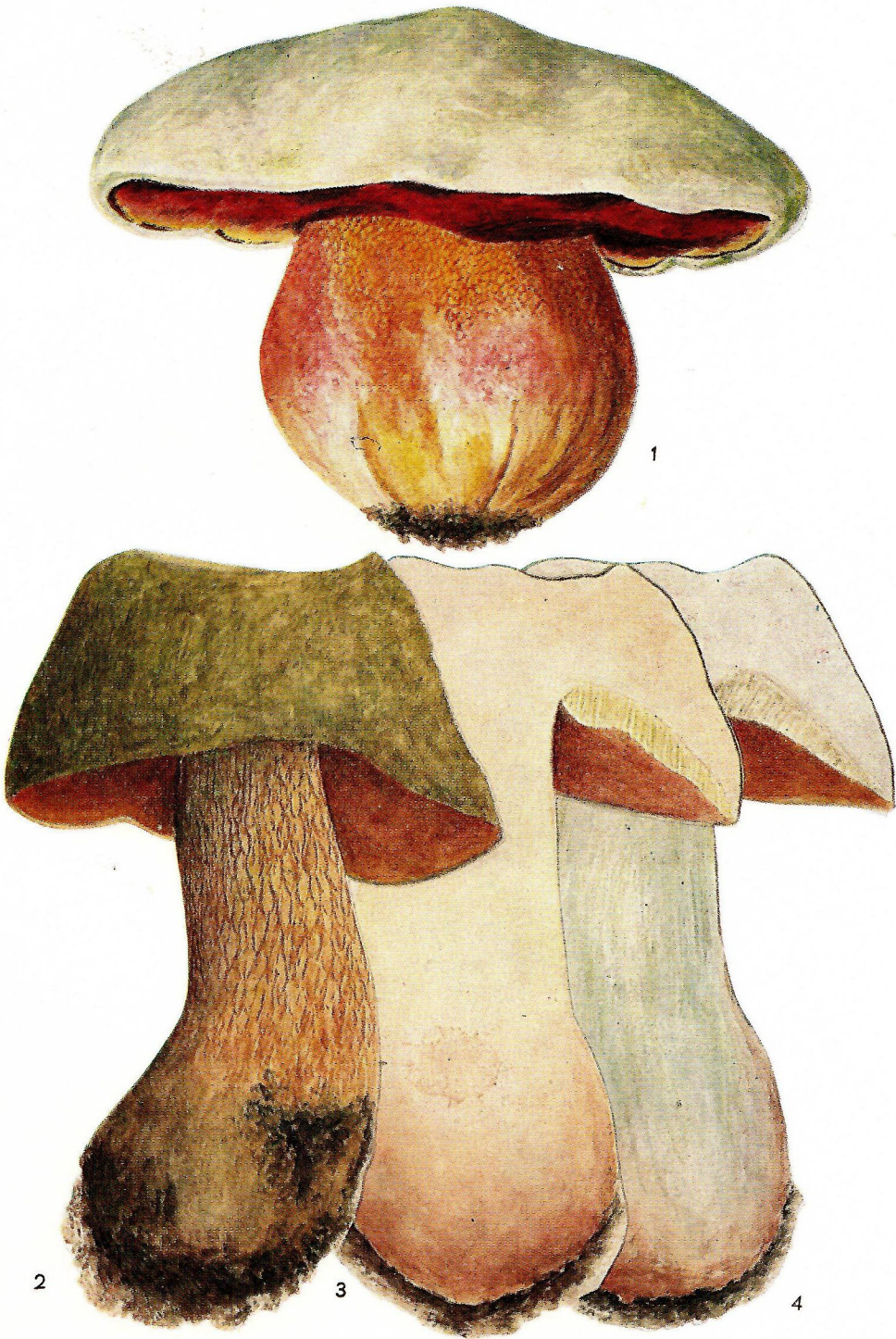
Plate 18

Boletus satanas Lenz

1 — Ripe fruit body from the environ of Darmstadt (Federal Republic of Germany) (after Kallenbach, 1, Fig. 7).

Boletus luridus Schaeff. ex Fr.

2-4 — Ripe specimen. Kuźnica Białostocka, August 3, 1934.



1 — *Boletus satans* Lenz 2-4 — *Boletus luridus* Schaeff. ex Fr.

Plate 19

Boletus erythropus (Fr.) Krombh.

1 — Very young fungus from the Świętokrzyskie Mts. (Łysica Mt.) May 20, 1934. 2-3 — Young fungus. Złoty Potok, August 23, 1936. 4 — Ripe fungus, Łączna, October 11, 1937.

Boletus rhodoxanthus (Krombh. ex) Kallenb.

5-6 — Ripe fungus and its cross section. Złoty Potok, August 23, 1936.



1-4 — *Boletus erythropus* (Fr.) Krombh. 5-6 — *Boletus rhodoxanthus* (Krombh. ex) Kallenb.

Plate 20

Tylopilus felleus (Fr.) Karst.

- 1 — Young fungus. Druskienniki (USSR), August 10, 1934;
2-3 — Ripe fungus. Rejów near Skarżysko, August 25, 1936.
4 — Ripe fungus. Wawer, September 9, 1937. 5-7 — Young
specimens, Todorkowce (USSR), July 26, 1934.



Tylopilus felleus (Fr.) Karst.

Plate 21

Tylopilus felleus (Fr.) Karst.

1-2 — Young fungi, Wawer, September 3, 1937.

Leccinum aurantiacum (St.-Amans) S. F. Gray f. *rufescens*
(Secr.) Konrad.

3-4 — Young fungus and its cross section. Birch-spruce
forest, Todorkowce (USSR), July 28, 1934. 5 — Young fungus.
Kuźnica Białostocka, August 12, 1935.

Leccinum aurantiacum (St.-Amans) S. F. Gray f. *aurantiacum*

6-7 — Young specimens. Klembów, August 21, 1937.



1-2 — *Tylopilus felleus* (Fr.) Karst. 3-5 — *Leccinum aurantiacum* (St.-Amans) S. F.
 Gray f. *rufescens* (Secr.) Konrad. 6-7 — *Leccinum aurantiacum* (St.-Amans) S. F.
 Gray f. *aurantiacum*.

Plate 22

Leccinum aurantiacum (St.-Amans) S. F. Gray f. *aurantiacum*

1-3 — Young specimens of various age. Laski near Warsaw,
September 29, 1935.

4-5 — Ripe fungus and its cross section. Mienia, September
25, 1935. 6-7 — Young specimens. Mienia, September 25,
1935.



Leccinum aurantiacum (St.-Amans) S. F. Gray f. *aurantiacum*.

Plate 23

Leccinum aurantiacum (St.-Amans) S. F. Gray f. *rufescens*
(Secr.) Konrad.

1 — Ripe fruit body from a pine forest. Ruciane, September
12, 1954. 2-4 — Fungi of various age. Kulesze Kościelne,
September 16, 1935.



Leccinum aurantiacum (St.-Amans) S. F. Gray f. *rufescens* (Secr.) Konrad.

Plate 24

Leccinum scabrum (Fr.) S. F. Gray f. *scabrum*

1-6 — Specimens at various developmental stages and cross section of one of them. Environ of Kuźnica Białostocka (Poland) and Todorkowce (USSR), August 3-27, 1934.

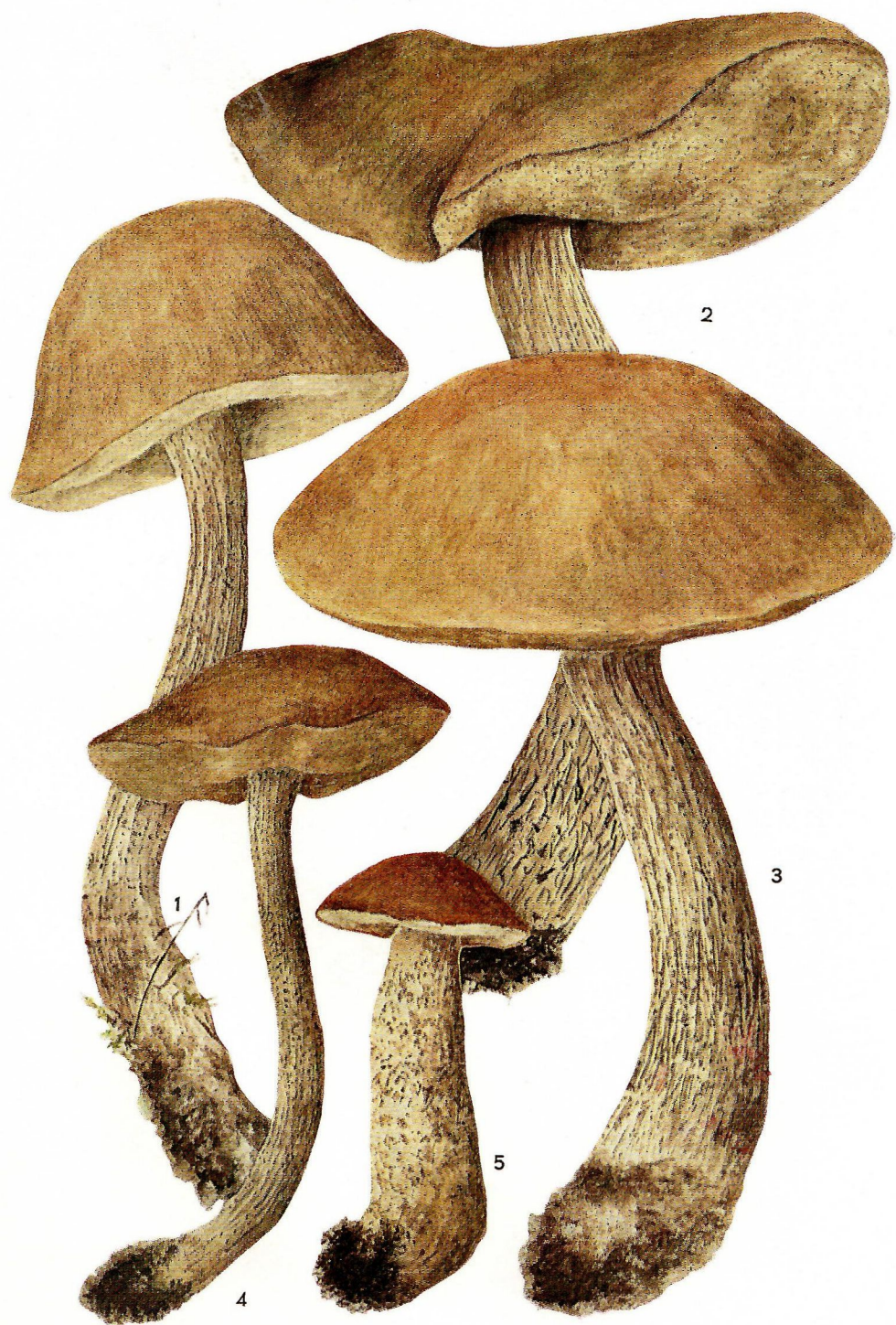


Leccinum scabrum (Fr.) S. F. Gray f. *scabrum*.

Plate 25

Leccinum scabrum (Fr.) S. F. Gray f. *scabrum*

1-2 — Ripe specimens. Chojnów near Piaseczno, June 18, 1934; leg. T. Pacyna. 3 — Old specimen. Todorkowce (USSR), August 7, 1934. 3-4 — Old and young specimens. Ruciane, September 12, 1954.



Leccinum scabrum (Fr.) S. F. Gray f. *scabrum*.

Plate 26

Leccinum scabrum (Fr.) S. F. Gray f. *scabrum*

1 — Ripe specimen. Kamień, August 13, 1957.

Leccinum scabrum (Fr.) S. F. Gray f. *melaneum* (Smotl.)
comb. n.

2-3 — Young specimens. Ruciane, September 2, 1954, August 5, 1954.

Leccinum scabrum (Fr.) S. F. Gray f. *chioneum* (Fr.) comb. n.

4 — Young specimen. Ruciane, September 7, 1954.

Leccinum scabrum (Fr.) S. F. Gray f. *scabrum*

5-9 — Ripe dwarf specimens collected during long-lasting drought. Mikołajki, August 7-14, 1947.



Leccinum scabrum (Fr.) S. F. Gray: 1 — f. *scabrum*. 2-3 — f. *melaneum* (Smotl.)
comb. n. 4 — f. *chioneum* (Fr.) comb. n. 5-9 — f. *scabrum*.

Plate 27

Leccinum griseum (Quél.) Sing.

1-6 — Specimen at various developmental stages. Environs
of Kuźnica Białostocka (Poland) and Todorkowce (USSR),
August 3-27, 1934.

Leccinum scabrum (Fr.) S. F. Gray f. *scabrum*

7-8 — Ripe specimens. Chojnów near Piaseczno, June 18,
1934, leg. T. Pacyna.



1-6 — *Leccinum griseum* (Quél.) Sing. 7-8 — *Leccinum scabrum* (Fr.) Gray,
f. *scabrum*.

Plate 28

Leccinum griseum (Quél.) Sing.

1-2 — Ripe specimens. Ruciane, September 7, 1954. 3-8 —
Young specimens. Tleñ, August 8-15, 1952.



Leccinum griseum (Quél.) Sing.

Plate 29

Leccinum scabrum (Fr.) S. F. Gray f. *scabrum*

1 — Specimen from Ruciane, September 7, 1954.

Gomphidius glutinosus (Fr.) Fr.

2 — Ripe specimen. Mikołajki, August 14, 1947.

Gomphidius rutilus (Fr.) Lund. et Nannf.

3 — Ripe specimen. Ruciane, September 21, 1957.

Strobilomyces floccopus (Fr.) Karst.

4 — Ripe specimen. Pieniny Mts., September 25, 1955.



1 — *Lecinum scabrum* (Fr.) Gray f. *scabrum*. 2 — *Gomphidius glutinosus* (Fr.) Fr.
3 — *Gomphidius rutilus* (Fr.) Lund. et Nannf. 4 — *Strobilomyces floccopus* (Fr.) Karst.

Plate 30

Porphyrellus pseudoscaber (Secr.) Sing.

1 — Ripe specimen. Zakopane, July 1954.

Paxillus involutus (Fr.) Fr.

2 — Ripe specimen. Tleń, August 15, 1952.

Paxillus atrotomentosus (Fr.) Fr.

3 — Ripe specimen. Szeroki Bór, August 17, 1955.

Gomphidius glutinosus (Fr.) Fr.

4 — Short specimen. Łeba, August 25, 1955.



1 — *Porphyrellum pseudoscaber* (Secr.) Sing. 2 — *Paxillus involutus* (Fr.) Fr. 3 — *Paxillus atroamentosus* (Fr.) Fr. 4 — *Gomphidius glutinosus* (Fr.) Fr.